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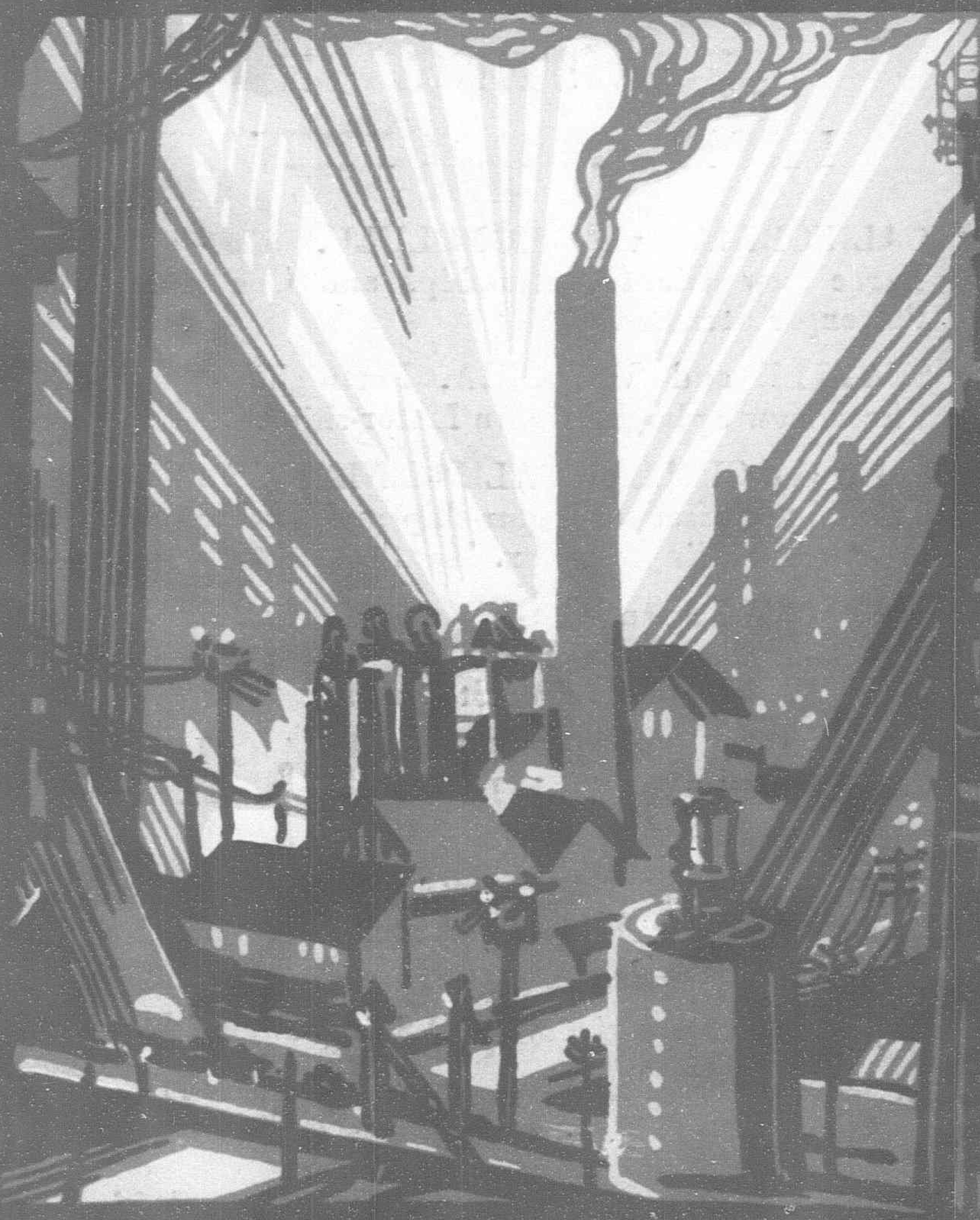

上海黃浦灘念四號

THE FALLACY OF THE LYTTON REPORT

FACTS ABOUT MANCHUKUO

THE TANNA TUNNEL

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The Far Eastern Review

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The Fallacy of the Lytton Report

The Population of Manchukuo is Not Overwhelmingly Chinese But is 75 Per Cent " Manchu "

With regard to the question of the independence of the newly formed Government of Manchukuo the Lytton Commission of Inquiry of the League of Nations reached a conclusion which was based wholly upon the assumption that the population of the new state overwhelmingly is Chinese. This assumption demonstrably is fallacious, and the fallacy of the assumption destroys the value of the conclusion that the Commission presented in its report. In the report of the Commission the right of self-determination is denied to the people of Manchukuo, because it was held that they are not a native stock, but essentially are Chinese. This is not true.

In order to enable the League of Nations to arrive at an equitable decision as to the rights of the people of Manchukuo to self-determination and independence, and, in order to keep the record straight so the world may judge of the merits and justice of its cause, the Government of Manchukuo submitted to the League the following facts :—

1. The population of Manchukuo is not 97 per cent Chinese, but at least 75 per cent " Manchu."
2. The Chinese Government has never taken a scientific population census. All estimates are pure guess-work, based on the returns of taxable households and allowing a certain number of adults and " mouths " to the family. The last census of this nature was conducted by the Manchu Government in 1910, in which the family in China Proper was estimated at 5.5 persons and 8.3 in Manchuria.
3. The Chinese Government has no vital statistics. It has never attempted to classify the population.
4. The only approximately reliable statistics presented to the League Commission of Enquiry, were compiled by the Research Bureau of the South Manchuria Railway. In this, and in all other compilations carried out by the Japanese, all inhabitants of Manchuria, other than Japanese subjects and foreigners, were classified as *Chinese*. The Chinese, having no statistics of their own to submit to the Commission, advanced these unofficial Japanese figures to establish and prove their case.
5. The Japanese immigration figures cover the years 1923 to 1930, the period of greatest influx. *The Manchurian Year Book* published by the Far East Economic Investigation Bureau, shows that although 5,687,000 immigrants entered Manchuria during these years, only 2,783,000 remained. The statistics of the Research Bureau of the South Manchurian Railway for this same period (quoted in the Supplementary Studies of the Commission), show 3,129,000 remaining in the country for the same period. The Government of Manchukuo concedes the higher figure. There are no records for the years prior to 1923. All reports to the effect that **millions** of Chinese have settled in Manchuria during the past two decades, are based on the above eight-year figures. Before and immediately after the Great War, the Commission states that the immigration was " temporary," that is, seasonal male labor, unaccompanied by wives or families. Not until 1923 did Chinese immigrants entering Manchuria begin to bring their wives with them, and then to not more than 17 per cent. To prove further that this seasonal labor movement was not permanent or contributed to any material increase in the basic population of the country, it is only necessary to refer to the Table on page 117 of the Supplementary Report of the Commission, which shows that 95 per cent of the workers returned to their homes at the end of five years.

   The Government of Manchukuo is willing to accept the Japanese estimate of those remaining in the country for the first two years of the highest migration (1923-1924) and concede that 150,000 annually remained in Manchuria for the 15-year period 1907-1922, a total of 2,250,000. It also accepts the statement of the Chinese Assessor that 100,000 immigrants entered annually in the years 1887 to 1900. It further concedes that all these workers remained in the country and extends the period to 1906, or a total of 1,900,000. These most liberal estimates show that in forty-three years, not more than 7,279,000 Chinese entered and remained in Manchuria. *Where then did the " millons " of Chinese farmers come from which the Commission says quietly occupied the land and determined its ownership after the Treaty of Portsmouth in 1905 ?* If the total population is now 28,198,000 and not more than 7,000,000 have settled in the country in the last forty-three years (in their great majority, single males), it leaves 21,000,000 to be accounted for. **Who are these people ? Where did they come from ?**
6. The Government of Manchukuo declares that these 21,000,000 people are Sons of the Soil, born in the State, the rightful heirs to the lands handed down to them by their forefathers.
7. In order to maintain their Homeland as a Reservoir or Base from which to draw replacements for their armies of occupation holding China in subjection, and as their natural refuge in the event of disaster or retreat, the Manchu Authority created Manchuria into a closed preserve, a Crown Area, the exclusive property of the Imperial Family, the Ten Hereditary Princes and the Twenty-four Banner Corps (eight Manchu, eight Mongol and eight Manchurian-Chinese). It then enacted and enforced rigid exclusion laws to keep the Chinese out of Manchuria. Although at various times in the last three centuries a limited immigration was encouraged to till the land as tenants of the Bannermen, the conditions of entrance were for all practical purposes equivalent to the naturalization laws of other countries. The immigrants lost their rights as Chinese and became naturalized Manchus, distinct and apart from the Chinese in China Proper. No Chinese could pass the frontier barriers and enter Manchuria without a passport issued by the Peking Authorities and *viséd* by the Banner Corps Headquarters. These regulations were enforced, even with officially-aided colonists, to the year of the Revolution of 1911. At no time did the Manchus

surrender sovereignty over their Homeland. Furthermore, in order to keep the blood strain pure and prevent the amalgamation of the two peoples, the Manchu Emperors prohibited intermarriage between the Bannermen and Chinese, a decree that was also strictly enforced up to 1902, when it was annulled.

8. This prohibition compelled the three privileged Banner Castes (Manchus, Mongols and Manchurian-Chinese) to intermarry amongst themselves only, and in three centuries they evolved an entirely new racial division, a homogeneous national unit, which, although not pure Manchu, is certainly not pure Chinese. Taking their name from that of their Homeland, these people are **Manchus**.
9. On the abdication of the Emperor, the Republic of China entered into a solemn contract with the Manchu Authorities which provided that the Emperor was to retain his title and enjoy "*the respect due to a Foreign Sovereign*"; to receive an annuity of Taels 4,000,000; to be permitted to reside in the Winter Palace; to enjoy the use of his private property and to be free to perform the customary ceremonies at the Imperial Tombs which were to be guarded by Republican troops. In addition, there were two other agreements, one concerning the privileges of the Manchu and Mongol Princes and the other the treatment of the Twenty-four Banner Corps, all three agreements being promulgated as the fundamental law of the Republic. Confiding in these solemn agreements, the Imperial Family, Princes and Bannermen did not perceive the immediate necessity of returning to their own country, but remained in Peking where they became prisoners of the Republic and saw their Homeland come under the despotic sway of a war-lord who usurped their authority. Every provision of the Abdication Agreements has been violated.
10. The Peking and Nanking Governments subsequently entered into various treaties with Foreign Powers which acknowledge and confirm their right to rule the entire country as it existed under the Empire of which Manchuria was an integral part. *These treaties, however, do not invalidate the Agreement between the Republic of China and the Manchus. That Agreement still stands as the Fundamental Law of the Republic.*
11. The dispute before the League as to whether or not Japan was justified in resorting to self-defense on the night of September 18, 1931, has nothing to do with the independence of Manchukuo. The people of Manchukuo frankly admit that they took advantage of the opportunity, providentially created, to free themselves from tyranny and oppression and resume their centuries-old independence. They do not hide behind Japan, but assume full responsibility for their actions.

* * *

The Fundamental Law of the Republic of China

(Generally referred to by the Chinese as "The Articles of Favorable Treatment," in which special provision is made for the rights of Manchus, Mongols, Mohammedans and Tibetans, who are considered as being outside the Chinese Nation).

(Signed February 11, 1912)

A. Concerning the Emperor—

The Ta Ching Emperor having proclaimed a republican form of government, the Republic of China will accord the following treatment to the Emperor after his resignation and retirement.

Article 1.—After abdication the Emperor may retain his title and shall receive from the Republic of China the respect due to a foreign sovereign.

Article 2.—After abdication the Throne shall receive from the Republic of China an annuity of Taels 4,000,000 until the establishment of a new currency, when the sum shall be $4,000,000.

Article 3.—After abdication the Emperor shall for the present be allowed to reside in the Imperial Palace, but shall later remove to the Eho Park, retaining his bodyguards at the same strength as hitherto.

Article 4.—After abdication the Emperor shall continue to perform the religious ritual at the Imperial Ancestral Temples and Mausolea, which shall be protected by guards provided by the Republic of China.

Article 5.—The Mausoleum of the late Emperor not being completed, the work shall be carried on according to the original plans, and the services in connection with the removal of the remains of the late Emperor to the new Mausoleum shall be carried out as originally arranged, the expense to be borne by the Republic of China.

Article 6.—All the retinue of the Imperial Household shall be employed as hitherto, but no more eunuchs shall be appointed.

Article 7.—After abdication all the private property of the Emperor shall be respected and protected by the Republic of China.

B. Concerning the Imperial Clansmen—

Article 1.—Princes, Dukes and other hereditary nobility shall retain their titles as hitherto.

Article 2.—Imperial Clansmen shall enjoy public and private rights in the Republic of China on an equality with all other citizens.

Article 3.—The private property of the Imperial Clansmen shall be duly protected.

Article 4.—The Imperial Clansmen shall be exempt from military service.

C. Concerning Manchus, Mongols, Mohammedans and Tibetans—

The Manchus, Mongols, Mohammedans and Tibetans, having accepted the Republic, the following terms are accorded to them :—

Article 1.—They shall enjoy full equality with Chinese.

Article 2.—They shall enjoy the full protection of their private property.

Article 3.—Princes, Dukes and other hereditary nobility shall retain their titles as hitherto.

Article 4.—Impoverished Princes and Dukes shall be provided with means of livelihood.

Article 5.—Provision for the livelihood of the Eight Banners, shall with all dispatch be made, but until such provision has been made, the pay of the Eight Banners shall be continued as hitherto.

Article 6.—Restrictions regarding trade and residence that have hitherto been binding on them, are abolished and they shall now be allowed to settle in any department or district.

Article 7.—Manchus, Mongols, Mohammedans and Tibetans shall enjoy complete religious freedom.

* * *

The main issue in the dispute between China and Japan is the independence of Manchukuo. The conclusion arrived at by the League Commission of Enquiry is :

> "that there is no general *Chinese* support for the Manchukuo Government, which is regarded by the local *Chinese* as an instrument of the Japanese."

The Commission based this conclusion on the assumption that the population of Manchuria is "*overwhelmingly Chinese.*" If it can be shown that the great majority of the people of Manchukuo are not Chinese, but Manchu in origin, in spirit, in traditions and in loyalty to their old sovereign, then the findings of the Commission must be revised.

With the exception of the Maritime Customs Trade Returns and Post Office Reports compiled by foreign experts, there are no reliable government statistics in China. No proper census has ever been taken. Vital statistics and classification of population are unknown.

The only estimates of the number of people living in Manchuria have been made by the Japanese Kwantung Government and the

Research Bureau of the South Manchuria Railway. The Japanese know the number of their own subjects residing in Manchuria; they also have accurate information as to the number of foreigners registered in their respective consulates, as well as the number of White Russians. All other inhabitants are classified as *Chinese*.

The population of Manchuria in 1930, is given in the *Manchuria Year Book* (1931) as 29,198,000, of which it is claimed that 28,259,873, or 96.8% are *Chinese*." The Report of the Commission of Enquiry says (page 25): "*those people are said to be Chinese or assimilated Manchus*." The Commission places the cart before the horse. It should have said: "these people are 'Manchus' or assimilated Chinese." It goes on to state that "the provinces of Shantung and Hopei have poured *millions* of destitute farmers into Manchuria" and that "without this influx, the territory could not have developed so rapidly."

> "After the Treaty of Portsmouth (1905), *millions* of Chinese farmers settled the future possession of the land. This immigration was in fact an occupation—peaceful, inconspicuous, but none the less real. While Russia and Japan were engaged in delimiting their respective spheres of interest in North and South Manchuria, Chinese farmers took possession of the soil and Manchuria is now unalterably Chinese."

Study No. 3 in the Supplementary Documents of the Report entitled "*Chinese Migrations to Manchuria*," reprints the statistics of the South Manchurian Railway, which show that the greatest migration from China Proper was during the period 1923-1930. "*During the period before and immediately after the War*," the *Report says*, "*the migration was 'temporary*,' *that is, purely seasonal labor*." If, during the period before and immediately after the War, the immigration into Manchuria was purely seasonal, where did those *millions* of Chinese farmers come from who quietly took possession of the soil after the Russo-Japanese War?

Where the Fallacy Lies

The fallacy of the Report consists in taking for granted that *millions* of Chinese entered Manchuria over a long period of years, and that this immigration carried with it the right of sovereignty. The number of immigrants entering *and remaining* in Manchuria for the eight-year period 1923-1930, (*the years of the heaviest exodus from China Proper*) was 3,129,135, an average of 391,000 per annum.

It should be emphasized that the statistics of the South Manchuria Railway for the years 1923-1930, constitute the only reliable data on the subject of Chinese immigration into Manchuria. Before that date there were no figures. Every study and report, official or otherwise, on the subject of Chinese immigration into Manchuria, is based on these eight year figures compiled by an unofficial Japanese Research Bureau attached to the South Manchuria Railway, interested primarily in ascertaining the volume of traffic over its lines.

The only Chinese statistical survey of Manchuria worth quoting is that prepared for the Third Conference (1929), of the Institute of Pacific Relations, by Mr. Chu Hsiao, Director for the Study of the North-eastern Provinces of the Nankai University at Tientsin. Mr. Chu cannot present any Chinese statistics, but reprints those prepared by the Research Bureau of the South Manchuria Railway for the period 1923-1928. He then says:

> "Until recently, Chinese immigrants went to Manchuria mostly for seasonal employments. As the territory is newly developed, labor is comparatively scarce. The high wages which Manchurian landowners pay for farm-hands attract many into the Three Eastern Provinces. Early in the Spring these yearly migratory workers left their homes for Manchuria and arrived there just in time to commence the tillage. For spring, summer and autumn they worked and when winter came, they took their savings, whatever amount they were, to return home for the new year festival. Some of them, of course, stayed to make permanent homes in Manchuria, but the majority went merely for the seasonal employment."
>
> "The situation has changed, however, with the change of events in recent years. The wars, famines and crushing taxes made life almost impossible in some of the provinces, particularly Shantung, and immigrants into Manchuria began to prefer permanent settlement in the new land to returning to the old. Consequently an important change took place in the nature of the immigration. *Before, immigrants went to Manchuria single. But recently they go with families. The percentage of women among the immigrants was 17.3 per cent for the port of Dairen in 1928*, and the number of those who return to their homeland is decreasing yearly."

The fact is established that before and immediately after the Great War, Chinese immigration into Manchuria was confined to seasonal *male* labor. This point is of great importance as proving that the increase of population in Manchuria before 1923, bore no relation to the influx of immigrants but represented the natural growth of the sons of the soil. Before that date the immigration consisted of purely seasonal *male* laborers who returned to their homes in Shantung and Chihli after the crops were harvested.

Before the Japanese firm of Mitsui and Company dispatched the first trial shipment of soya-beans to England in 1908, and created an export demand for this commodity, seasonal labor in Manchuria was confined to meeting the requirements of Japanese railway construction and mining development. During the Great War, the recruiting of Labor Battalions for work behind the Allied lines, provided a more profitable outlet for the Shantung and Chihli workers than could be found in Manchuria. The period 1908-1922 was not marked by any great "immigration" movement from North China to Manchuria. In order to arrive at a fair estimate it may be conceded that 150,000 Chinese immigrants annually remained in Manchuria in the sixteen years 1907 to 1923, a total of 2,400,000. No records exist to substantiate this estimate. All the evidence goes to prove that the number of immigrants who remained in Manchuria during that period was practically nil. The year 1907 is selected because prior to that date no Chinese could pass the barriers at Shanhaikwan without a passport issued by Peking and viséd by the Banner Corps Headquarters, a regulation that was enforced up to 1911. Permission was conceded only to those who entered as tenants of the Banner Corps.

Seasonal Laborers and Only Males

In a Memorandum submitted to the League Commission of Enquiry (Document 17), the Chinese Assessor states that the last remaining official barriers to Chinese immigration into Manchuria were removed in 1887, and *from that date to 1900 it is estimated* that 100,000 immigrants entered annually. The Chinese Assessor does not state how many of these "immigrants" (in reality) seasonal male laborers returned to their homes at the expiration of their contracts. If later statistics are taken as a guide, probably not more than 10 per cent remained in the country. However, for the purposes of this study, it is conceded that all these "laborers" became permanent settlers, and the period is extended from 1900 to 1906, or nineteen years. This gives a total of 1,900,000.

The Chinese Assessor publishes in full the regulations governing the entrance of immigrants into Manchuria under the 1907 official colonization schemes, which provide that on arrival they must report to the Immigration Office, fill in blank forms and obtain a *passport* before proceeding to the district designated by the Bureau.

These immigration regulations of 1907 indicate that at no time prior to the Revolution were Chinese permitted to enter Manchuria, except under conditions which recognized the full sovereignty of the Banner Corps over their Homeland. The acceptance by the immigrants of these passport conditions was equivalent to a declaration of intention to take out citizenship papers in other countries preparatory to full naturalization. When these Chinese immigrants crossed the frontiers, they came under the rule of the Banner Corps and became legally *Manchus*.

Conceding, therefore, that the above estimates are approximately correct, we have the following:

1.	Number of immigrants remaining in Manchuria for the period 1923-1930	3,129,000
2.	Estimate for the 15 year period 1907-1922 at 150,000 annually	2,250,000
3.	Estimate for the 19 year period 1887-1906 ..	1,900,000
	Total for the 43 year period 1887-1930.. ..	7,279,000

If the total Chinese population of Manchuria is 28,259,000, and at the most liberal estimate only 7,279,000 Chinese immigrants have entered the territory in forty-three years it leaves 21,000,000 to be accounted for. **Who are these people? Where did they come from?**

The archives of the Manchu Dynasty show that in 1616 the population of what is now known as Manchukuo, was about 1,600,000. When, in 1644, the Chinese invited the Manchus to pacify China Proper, an army of Eight Principal Banners, subdivided into 24 units (8 Manchu, 8 Mongol and 8 Chinese), comprising 480,000 men, left Manchuria for this purpose, conquering and imposing their rule over a population estimated at 50,000,000. It should be emphasized that the original Eight Chinese Banner Corps were *Manchurians.*

In 1624, the Manchus set up their capital in Mukden and extended their rule over the small Chinese colonies in the Liao River Region. All Chinese residing outside the Wall became Manchu subjects and their fighting men were enrolled into Banners ranking socially with the dominant caste *and apart from other Chinese.* These original Banner Corps were confined to young fighting men who left their families and dependents "outside the Wall," forming what is known as the "Reservoir," furnishing replacements in the ranks of the army of occupation. Whatever sovereignty the Chinese exercised over the southern part of Fengtien ("within the palisade") by right of colonization and spread of their culture and civilization, disappeared and passed to the Manchus by right of conquest. The Chinese domiciled in Fengtien Province at the time of the conquest, lost their rights as subjects of China and became Manchus.

Intermarriage Forbidden

In order to keep the racial strain pure and preserve the fighting qualities of their armies, the Manchu Emperor prohibited the Bannermen from marrying Chinese, a rule that was strictly enforced up to 1902, when the Decree was annulled. They could, however, intermarry amongst themselves. These Bannermen lived under a patriarchal system in which polygamy and concubinage were permissible and practised. There are no statistics to show the natural increase of this basic tribal population but if we apply the lowest European or monogamistic rate of increase to a people living under a patriarchal or polygamistic system, those 1,600,000 Bannermen would have doubled their numbers every hundred years. When it is considered that the Koreans have doubled their numbers in the last 22 years; that wherever reliable statistics are kept, it shows the Chinese doubling their numbers in 35 years, the Javanese in 33 years and the Japanese in 45 years, it is fair to assume that the Bannermen were as prolific as their immediate neighbors. Assuming, however, that these Bannermen required one hundred years to double their numbers, there should be 12,800,000 or more descendants residing somewhere within the confines of Manchuria, Mongolia, Chinese Turkestan or China Proper. The checks of Nature which keep down the population increase in China Proper, did not apply in Manchuria and Mongolia. There were no floods, famines, or wars in these territories. Not until 1910 did pestilence in the form of pneumonic plague appear in Manchuria, so these people prior to that date were permitted full scope to multiply under normal and natural conditions. The Minchengpu census of 1910 estimates the number of "mouths" to the family in Fengtien (Manchuria) as 8.3, as against 5.5 in China Proper, or 50 per cent higher, a condition attributable to the absence of those checks which keep down the increase in China Proper.

The above estimate of the rate of increase in China Proper is the same as that advanced by E. H. Parker in his standard work on "China." In the chapter on "Hazy Statistics" he says that the last recorded number of households taken by the Manchus, was in 1734, when there were 26,500,000 for all China. At the time of the conquest, the population of China was estimated at 11,000,000 households with five adults and "mouths" to the family. The population of China did not exceed 100,000,000 until the beginning of the 18th century and then doubled itself every century. So, according to his estimate, it was 50,000,000 in 1644 when the Manchus took over the power and, despite all wars, pestilence, floods, famines and other natural checks, the population has doubled itself every century since that date.

It is stated that the Manchu invasion practically denuded Manchuria of its population, but there are no figures available to show the actual number which remained, except the population estimates in the records of the Manchu dynasty, which places it at nearly a million. However, if we leave only 500,000 and apply the rate of increase indicated by the Minchengpu census, we have a doubling of numbers every 66.2/3 years or, some 8,000,000 people who, by reason of their birth in the State, are Manchus. Or, if we base our estimate on the figures recorded in the archives of the Manchukuo dynasty, 1,000,000, and allow the same rate of increase, there should be 16,000,000 descendants alive to-day. Should we apply this ratio of increase to the original total of 1,600,000, there would be 25,600,000 descendants. No matter how the argument is presented, we cannot escape the fact that these people exist, any conflict of opinion arising from the fact that the Chinese have kept no statistics.

The Report of the Commission of Enquiry, referring to the conquest of China, says:

> "The exodus of the Manchus and their Chinese allies greatly reduced the population of Manchuria. However, in the south, Chinese communities continued to exist. From this foothold a few settlers spread across the central part of Fengtien Province. Their number was increased by a continuous infiltration of immigrants from China *who succeeded in evading the exclusion laws,* or who had profited by their modification from time to time. Manchus and Chinese became still more amalgamated and even the Manchu language was virtually replaced by Chinese."

The Law of Conquest

The Commission of Enquiry overlooks the law of conquest which prevailed in the 17th century, and which, up to the promulgation of the Hoover Doctrine in 1932, formed the basis of all international law relating to sovereignty. After 1616, the Chinese colonists in the Liao River districts of southern Fengtien were no longer Chinese but Manchus, who, on swearing allegiance to their new rulers, were permitted to hold their lands and spread across the central part of Fengtien Province, that is, "within the Palisade," which separated this district from the region of the outer tribes. The Commission goes on to say that "their number was increased by a continuous infiltration of immigrants from China who succeeded in evading the exclusion laws."

If the original Chinese settlers in southern Fengtien became Manchus by conquest, and for three centuries held their lands and privileges under Manchu law, what legal claim have their present day descendants to Chinese nationality? If their number was steadily increased by Chinese smuggled into the territory in violation of the Manchu exclusion laws, what legal rights have the descendants of these law-breakers to a voice in the government of that country? If, after three centuries, a government can lay claim to sovereignty over a territory settled by colonists who were afterwards conquered by a stronger race, then the precedent is created for other very interesting adjustments in the *status quo.* If the descendants of "boot-legged" immigrants who have successfully evaded the exclusion laws and escaped deportation, are entitled to the rights of citizenship in countries whose laws they have set at naught, another dangerous precedent will be created.

The whole trend of the Commission's Report is to prove that the people of Manchuria are Chinese in nationality, civilization, culture and all the other characteristics which distinguish the Mongolian type from all other races. Its presentation of the facts from this angle, is to support the Chinese in their claim to sovereignty over a vast hinterland whose southern fringes were settled by their colonists in the dim dawn of history when the Phoenicians were doing the same thing in the Mediterranean, and who, like the latter, were subsequently amalgamated with their conquerors. The impression is created that in this "amalgamation" the ruling caste lost their characteristics, but the legal fact remains that these Chinese had become Manchus, and those who originally enrolled or were subsequently admitted into the Banners, enjoyed all the rights and privileges of this all-powerful caste. As there was no intermarriage between the Bannermen and the non-Banner Chinese, there could have been no amalgamation of the two peoples. The Banner caste remained the Lords of the Soil which the non-Banner Chinese tilled for them as Tenants.

An analysis of the population of China in the *China Year Book (1932)* (page 1) states:

> "The taking of a census by the methods adopted in Western nations has never yet been attempted in China, and consequently estimates of the total population have varied to an extraordinary degree. Until recently the nearest approach to a reliable estimate was, probably, the census taken by the Minchengpu (Ministry of Interior) in 1910, the results

of which are embodied in a report submitted to the Department of State at Washington and published in the *Daily Consular and Trade Reports* of July 13, 1911. It was pointed out that even this census could only be regarded as approximate, as with a few exceptions, households and not individuals were counted. The families of the whole country, exclusive of Tibet, were returned as follows :—

"China Proper	56,312,256
Metropolitan District (Peking)	831,266
Manchuria	1,780,308
Sinkiang	453,477
Manchu Military Organization	309,151
Dependencies	138,400

A census of individuals taken in various parts of China provided a clue to the number of persons per family. The average number was found to be 5.5, which multiple was used except in the case of Fengtien.* in Manchuria, where the much higher multiple of 8.3 was adopted. Worked out on this basis, the following figures were obtained :

China Proper	304,003,000
Metropolitan District	5,671,000
Manchuria	14,917,000
Sinkiang	2,491,000
Manchu Military Organization	1,700,000
Dependencies (exclusive of Tibet)	760,000"

The above figures do not take into account the Manchu Military Reserves domiciled "outside the Wall." The main force of the Eight Manchu Banners was encamped in and around Peking. Outside Peking was the Military Cordon of Twenty-five Cities in Chihli, at which were settled military colonies drawn from the Eight Banners. In addition, there were also the eighteen provincial garrisons to hold down the conquered country, the main garrisons being located at Chengtu (Szechuen), Kingchow (the Hupeh outlet of the Yangtze Gorges), Nanking, Chinkiang, Hangchow, Foochow and Canton.

In his book, "*The Fight for the Republic in China*" (1918) "Putnam Weale"† says that at the time of the Revolution the *Manchu* people numbered at the maximum 5,000,000 souls, distributed as follows : 2,000,000 in the Peking District, 500,000 or possibly 750,000 throughout China Proper, and 2,000,000 to 2,500,000 in Manchuria Proper.

In using the word "Manchu" it is clear that Putnam Weale did not include the Mongols. The Mongol Bannermen were never permitted inside the Wall to garrison the strategic centers defending Peking. Remembering the days of their greatness, the Mongols secretly harbored the hope that they would again become the conquerors of China and reseat their Khan on the Dragon Throne. National security as conceived by the Manchus was to protect themselves against this menace and to this end concentrated their military strength along the north-western frontiers to be prepared against invasion from that direction. This explains why twenty-five garrisons were quartered in the various cities of Chihli Province and why the Mongol Bannermen cannot be included in Putnam Weale's estimate.

The Manchu Garrisons

As to the so-called "Chinese Bannermen," the same rule applies. This element formed the minority of the various banner corps and, in the main, were domiciled in the "reservoir" outside the Wall, enjoying all the rights and privileges of the ruling caste. If these Manchurian-Chinese are classified as pure Manchu, Putnam Weale's figures would have to be revised to include a large proportion of population of the Three Eastern provinces, who legally and by every known law of nationality were part of the Manchu nation. This would make his estimate so top heavy as to eliminate it as trustworthy evidence. When it is remembered that the Manchu garrisons in and around Peking and occupying the provincial capitals and strategic centers were composed almost exclusively of pure Manchus under the command of their Tartar Generals, it will be seen that Putnam Weale's estimate applied exclusively to this element alone.

If there were 5,000,000 Manchu people in 1911 and the Manchu Military Organization comprised 1,700,000, it indicates that there were 3,300,000 more Manchus to draw on for reserves or replacements. Applying the ratio of the Minchengpu Census of 5.5 to the family, we have 600,000 more men of fighting age to add to the 309,000 reported in the official census, or a total of 909,000. There were approximately as many Mongol and Chinese Bannermen and their families as there were Manchus. There is no way of arriving at any estimate of the number of these people domiciled in the "Reservoir," except by computing the normal increase of the original Bannermen in the last three centuries at 12,800,000. If we accept the 1910 Minchengpu population figures for Manchuria as 14,917,000 and deduct these Bannermen, it would leave 2,117,000 to be classified as pure Chinese.

It is significant that in the Supplementary Documents of the Report of the Commission of Enquiry (page 23) it is noted that a representative of the Manchu-Mongol League at Harbin, (Mr. Ilichun) testified that "*there are still in Manchuria between six and ten million people with Manchu blood, admittedly mixed with Chinese.*" The Commission however rejected this statement as obvious propaganda.

As pointed out, prior to 1907, no Chinese could own or lease land in regions "outside the Wall," except as tenants or dependents of the Banners. On various occasions during the past three centuries, the bars which excluded the Sons of Han from Manchuria were let down, but even this incentive was not sufficient to entice laborers from China Proper to work their lands as tenants, as is indicated by the further fact that the Manchus at last had to offer special inducements, even to the grant of free public lands, in order to encourage such immigration. It is clear, however, that all immigrants from China Proper entering these Crown Lands or Domains of the Bannermen, could do so only by swearing fealty to the Manchu Dynasty, a procedure similar in every way to the Naturalization Laws of other countries. At no time did the Han immigration into Manchuria carry with it equal rights with those born in the country. Many Chinese slipped in illegally and found jobs as petty farm laborers, or engaged in contraband activities, but they were lawbreakers, criminals in the eyes of the Manchu law, and exposed at all times to deportation.

All Chinese who resided in Manchuria were divided into the following categories: (1) Tenants of the Imperial Household ; (2) Tenants of the Ten Hereditary Princes ; (3) Tenants of the 24 Banner Corps (8 Manchu, 8 Mongol and 8 Chinese). *There were no exceptions to this rule.* At the time of the Revolution it is estimated that the number of these tenants approximated 3,000,000, which, added to the twelve to thirteen million Bannermen, makes a total of 15 to 16 million domiciled in Manchuria in 1911, all owing allegiance to the Manchu Emperor. All Chinese living in Manchuria in excess of these figures, were there illegally.

Where the Commission Erred

It is clear from the above figures that the population of Manchuria, exclusive of about 7,000,000 Chinese immigrants, in forty-three years represents the increase of the old native stock and their tenants domiciled in the territory, outwardly Chinese, but Manchu (Bannermen) in heart and spirit, loyal to their sovereign and true to the traditions of their race. It might be urged that same proportion of the natural increase in population is due to this immigration, but when it is remembered that up to 1923 the influx was confined to seasonal male labor, and that not until that date were they accompanied by wives or families, and then only up to 17 per cent, the contention cannot be sustained. It might vary the total a few per cent, but would not alter the outstanding truth revealed by the figures that instead of 96.8 per cent of the population being Chinese, the proportion does not exceed 25 per cent and, that the overwhelming majority of the people up to 75 per cent of the total, are the direct descendants of the Manchu, Mongol and Chinese Bannermen, or their Chinese Tenants.

The repeated references of the Commission to the **Millions** of Chinese farmers who took possession of the soil after the Treaty of Portsmouth (1905), simmers down to a total of not over 5,300,000, leaving a population of 23,000,000 to be accounted for. Until a scientific census can be taken of all the people of Manchukuo, with

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*"At that period, Fengtien was the capital of the Three Eastern Provinces, the seat of the Tartar General. The geographical term "Manchuria" was never employed by the Chinese. "Fengtien" must be taken as representative of the Three Eastern Provinces, known to the outside world as "Manchuria."

†The late Mr. Lenox Simpson, one of the foremost authorities on Chinese history.

full information as to their antecedents, these people must be classified as the descendants of the Bannermen and their Chinese Tenants, who alone have the right to be considered in any disposal of their territory. In proving that the population is not overwhelmingly Chinese, but overwhelmingly Manchu (Bannermen), it connotes an earnest desire for independence on the part of the latter.

The spokesmen for Nanking invite attention to the fact that the principal members of the Manchukuo Government are *Chinese* whose ancestral homes are still found in China Proper, but fail to mention that these Chinese names are borne by men who have remained loyal to the monarchy. It is only necessary to invite attention to the appended list which gives the names of 29 of the highest officials of the Government of Manchukuo, of which 23 belong to members of the old Manchu, Mongol and Chinese Banner Corps, or their *Chinese Tenants.* One is a member of the Imperial Clan. The other *Chinese* names are those of men who have remained loyal to the ideal of a constitutional monarchy or the principles of "Wang Tao," which underlie the Oriental conception of Good Government. In addition to the appended list of names, there are many more Bannermen and Imperial Clansmen holding important positions in the new Government. Over two hundred sons of high officials of the various Banner Corps, educated in Japanese military schools since 1912, are now serving as officials in the Manchukuo army, while the bodyguard of the Chief Executive is composed in the main of sons of Mongol princes sworn to defend the person of their Sovereign.

For Nanking to make out a case based on the claim that Chinese names predominate in the new Government of Manchukuo whose ancestral homes are still to be found in China Proper, and citing the names of Chang Tso-lin and others, is merely an attempt to throw dust in the eyes of the world. The erstwhile bandit, Chang Tso-lin, who became ruler of Manchuria, may have his ancestral home in Shantung Province, but for many years prior to the Revolution his family resided near Chinchow as tenants of the Manchu White Banner Corps.

During the Revolution of 1911, the main argument of the "Republican" leaders against the rule of the Manchus, was that they were "*foreigners*," a distinction emphasized in the Abdication Agreement of February 11, 1912, under whose terms the Emperor was to retain his title and enjoy the "*respect due to a Foreign Sovereign*"; to receive an annuity of Taels 4,000,000; to reside temporarily in the Winter Palace, but to remove later to the Eho Park; to enjoy the use of all his private property and to be free to perform the customary ceremonies at the Imperial Tombs which would be protected by Republican Guards. In addition, there were two other agreements, one concerning the privileges of Manchu and Mongol princes, and the other the treatment of the Twenty-four Banner Corps, all three agreements being promulgated as the fundamental law of the Republic. Because the Bannermen were not in a position to enforce fulfilment of these agreements, they were callously violated. The annuity to the Emperor and the Mongol and Manchu princes, and the pay of the Manchu, Mongol and Chinese Bannermen, was never adequately met. Their private and communal property was appropriated by the Government, the Imperial Tombs were violated and robbed by the Republican troops, and the title of the Emperor as a Foreign Sovereign was annulled on November 25, 1924. Whatever authority over Manchuria may have been acquired by the Republic under the terms of the Abdication Agreement, was forfeited by the violation of that Agreement.

The Chinese Contention

The Chinese contend that when the Manchus established their power at Peking, the Emperor brought with him Manchuria and Mongolia as his share of the new partnership, or, as the Chinese put it, "his marriage portion on the union between the North and the South." But when the marriage was cancelled, the dowry was confiscated; the shares were appropriated and there was no redress. The Manchu Emperor never surrendered his Homeland to the Republic and, when the opportunity presented, the people of Manchuria and Mongolia threw off the yoke, declared their independence and invited their old Ruler to become their Chief Executive.

The Report of the Commission says (page 27):

> "When the Revolution broke out in 1911, the Manchurian authorities who were not in favor of the Republic, succeeded in saving these provinces from the turmoil of civil war by *ordering* Chang Tso-lin, who was later to become the dictator of both Manchuria and North China, to resist the advance of the revolutionary troops."

This passage in the Report corroborates the statements in the telegrams addressed to the League by responsible leaders of Manchukuo to the effect that Chang Tso-lin derived his powers, not from any government in China Proper, *but from the people of Manchuria.* Chang was a Manchurian, a son of the soil, and the people elected him to defend their independence. Like all Chinese who rise to power, as soon as he became strong enough, he defied the will of the people and set himself up as Dictator. By raising huge armies and building the largest arsenal in Asia, he was able to impose his will upon the people who elected him to office. It is necessary to emphasize this fact in order to answer that paragraph in the Report of the Commission of Enquiry (pages 28-29) which says:

> "The independence declared by Marshal Chang Tso-lin at different times, never meant that he or the people of Manchuria wished to be separated from China. His armies did not invade China as if it were a foreign country, but merely as participants in the civil war. Like the war-lords of any other province, the Marshal alternately supported, attacked, or declared his territory independent of the Central Government, but never in such a way as to involve the partition of China into separate states. On the contrary, most Chinese civil wars were directly or indirectly connected with some ambitious scheme to unify the country under a really strong Government. Through all its wars and periods of "independence," therefore, Manchuria remained an integral part of China."

The first quotation from the Report answers the last. It is also worth recalling that while Chang Tso-lin was conquering China Proper and setting himself up as Dictator in Peking, Dr. Sun Yat-sen declared the independence of Canton and entered into an alliance with Moscow in order to drive this Manchurian adventurer back into his own country.

That Chinese names predominate in Manchuria merely means that the Chinese Bannermen and their Tenants naturally retained their family names and that after the Revolution, the Manchus in their great majority also adopted Chinese names, language and customs in order to save themselves from persecution.

There was no difficulty about this. The Manchu was distinguishable by having only two names while the Chinese had three. To Sinofy his name, the Manchu simply added another character in the same way that plain John Smith might become John Thomas Smith, or by hyphenating his father's and mother's names into John Jones-Smith. The Chinese immigrants who settled in Manchuria, naturally preserved their family names, thus giving strength to the argument that as all the people have Chinese names, they must of necessity be Chinese subjects, a theory that if applied to Europe would somewhat complicate international relations.

A Dangerous Precedent

To admit the claim that Manchuria belongs to the Chinese by reason of their having settled on the lands that belonged to the Manchus, to the point where they allegedly out-number the original inhabitants, is to create a precedent that may have far-reaching effects upon the sovereignty of other peoples too weak to defend themselves against the influx of undesirable or economically-inferior aliens. The phenomenon of conquest by peaceful penetration to the point where the trade, property and wealth of another country is controlled by an alien people, and the character of the native population is undergoing a change through intermarriage, is being witnessed in other lands of the Far East, in the Islands of the South Seas and Oceania and even in Latin America. In order to protect themselves against this silent invasion, other peoples have resorted to drastic immigration laws and in one state of Latin America, even to wholesale deportation and confiscation of the wealth so acquired.

The Chinese can prove by going back two, three or four thousand years before the Christian era, that they colonized not only what is known as China, but all the regions to the North, South, East and West. The Chinese, however, are not so keen about claiming kinship with the Mongol "Barbarians" and the Manchu "Pig-men." They were so apprehensive of these tribes that they built a wall, a thousand miles long, to keep them out of their country. All Chinese historians agree that their

"colonization" towards the north-east, stopped somewhere around the Liao River Valley or the southern part of what is now known as Fengtien Province. Beyond that, outside the "palisade," to the north and east, roamed the nomadic tribes which were finally united under one leader and called themselves Manchus. They then imposed their rule over the isolated Chinese settlements in the Liao Valley and in 1631, fixed their capital at Mukden. From 1644, the date of the Manchu conquest of China, up to 1911, the records reveal that the Manchus endeavored by every means within their power to bar out the Hans and preserve their Homeland as a Reservoir from which to draw the troops required to hold their conquest and as a natural refuge to which they could retreat in the event of defeat. Although at various times the bars were let down and immigration encouraged, there is no evidence that the influx was so great as to swamp the original inhabitants, that the latter died out and disappeared, or that they surrendered their sovereignty.

When it is remembered that the Eight Main Banner Corps under command of their Hereditary Princes existed until 1911; that these Manchu, Mongol and Chinese Bannermen had exclusively intermarried amongst themselves for three centuries, it is clear that this intermingling over such a long period materially changed their original characteristics and created a new type, just as the old dominant Anglo-Saxon strain in the United States is gradually being metamorphosed by mixture with the newer Mediterranean and Eastern European types. It may be argued that the Manchus and Mongols were absorbed by the Chinese, but when it is remembered that up to 1902, marriage between the Bannermen and Chinese was prohibited, just as good a case can be made out that the Chinese and Mongols were absorbed into the more virile Manchu type. But whether Manchu or Chinese, it is obvious that in these three countries of intermarriage, the original 1,600,000 Bannermen of all categories, with their families and dependents, living under a patriarchal system, evolved a composite type which has been generally accepted as Chinese. That a new racial type has emerged from this melting pot after three centuries of intensive inbreeding between the three privileged castes, is clearly discernible to even the most casual observer.

The Hans claim that these people are Chinese. Inasmuch as they all now speak the same northern dialect, dress in conventional Chinese (in reality Manchu) clothes and in other ways take on the outward appearances of the Northern Chinese, this is true, but there exists a wide gulf between these people and the Sons of Han. Physically, mentally, linguistically, and in every other way there is as great a difference between the typical Manchurian and the Chinese of the Central and Southern Provinces, as there is between the Nordic and the Mediterranean types. *These people may not be pure Manchu, but certainly they are not pure Chinese.* Although biologically part of the Mongolian race, politically these people are **Manchu,** the rightful owners of a Land whose complete independence was never contested until recent years. Admission of Chinese farm laborers under special naturalization laws, even to the point where the latter outnumber the native population, does not carry with it the right to claim sovereignty, or, if even for a few years, this alien majority succeeded in illegally grasping the power of government, it does not deprive the legitimate owners of the Land of their right to re-establish their authority and assert their old independence when the opportunity to do so presents itself.

Chinese names, Chinese language, Chinese customs, Chinese civilization, and an analogous economic life, do not denote Chinese nationality any more than English names, language, characteristics and customs signify British nationality, or French names, and French civilization carry with them French nationality. The people of Manchukuo, in fact, do not understand the language of the Southern faction which claims the right to rule over them. Under similar conditions, a Commission of Five Asiatics, accompanied by a group of eminent Confucian scholars visiting Lyon and Geneva and Lille and Brussels, would conclude that Geneva and Brussels belong to France. It would decide that Roussillon was Catalan, that Finland and the new Baltic States were indisputably Russian and would refuse to recognize any necessity for the existence of the tri-lingual Swiss nation. The Commission of Asiatics would find other curious political paradoxes arising out of wars of conquest, treaties, alliances, balances of power, application of the doctrine of self-determination and other complicated adjustments, and would finally come to the wise conclusion that Europe was passing through a period of transition and should be permitted all the time necessary for some one faction to establish a strong, central government that would unite the Continent in one harmonious whole. The Commission would conclude that as the people all dressed alike, looked alike, and were bound together by the same social customs, religion, culture and civilization and by a common economic system, they constituted one nation. The Commission of Five Europeans which went to China, could not distinguish the difference between the Manchus and the Hans and concluded that as they both belonged to the same race, they must indisputably form part of the same nation. This is the fallacy of the "Lytton Report."

* * *

Nationality of Leading Officials

of the

Government of Manchukuo

Cabinet Members.		
Prime Minister.	Cheng Hsiao-heu.	*Chinese* Tutor to the Chief Executive
Minister of the Interior	*Tsang Shih-yi*	Chinese Bannerman
Vice-Minister of the Interior	Pao Kang	Manchu Bannerman
Minister for Foreign Affairs	Hsieh Chieh-shih	*Chinese*
Minister of War	*Ma Chan-shan*	Tenant of Chinese Bannerman
Vice-Minister of War	Wang Ching-hsiu	Chinese Bannerman
Minister of Finance	*Hsi Hsia*	Imperial Bannerman
Vice-Minister of Finance	Sun Chi-chung	Chinese Bannerman
Minister of Commerce	Chang Yen-ching	11th Son of Viceroy Chang Chih-tung
Minister of Communications	Ting Chien-hsiu	*Chinese*
Minister of Justice	Feng Han-ching	*Chinese*
President of Legislative Yuan	Chao Hsin-po	Chinese Bannerman
President of the Central Yuan	Yu Chung-han	Tenant of Chinese Bannerman
President of the Privy Council	Chang Chih-hui	do.
Vice-President of the Privy Council	Tang Yu-lin	do.
Privy Councillor	Yuan Chin-kai	*Chinese*
,, ,,	Lo Chin-yu	*Chinese*
,, ,,	Chang Hai-pong	Tenant of Chinese Bannerman
,, ,,	Sun Chi-chang	do.
,, ,,	Kuei Fu	Tartar General of Mongol Banner Corps
Governors of Provinces, etc.		
Governor of Mukden Province	*Tsang Shih-yi*	
Commander-in-Chief of the Defense Forces of Mukden Province	Yu Chih-shan	Tenant of Chinese Bannerman
Governor of Kirin Province	*Hsi Hsia*	
Commander-in-Chief of the Defense Forces of Kirin Province	Chi-hsing	Manchu Bannerman
Governor of Heilungkiang Province	*Ma Chan-shan*	
Commander-in-Chief of the Defense Forces of Heilungkiang Province	Cheng Chih-yuan	Tenant of Chinese Bannerman
Chief of Special District	Chang Ching-hui	Tenant of Chinese Bannerman
Mayor of Changchun	Chin Pi-tung	7th Son of Prince Su
Mayor of Mukden	Yen Chuan-pa	Son of Tartar General of Manchu Banner Corps
Commander-in-Chief of the Manchukuo Gendarmerie	Te Fang-e	Manchu Bannerman
Chief of Police	Hsin Chang-yu	Chinese Bannerman
President of Chinese Eastern Railway	Li Shao-keng	*Chinese*

In this list of 29 names of the high officials of the Government of Manchukuo, 22 belong to the old Manchu, Mongol and Chinese Banner Corps or their Chinese Tenants, and seven represent pure Chinese names, whose bearers have remained loyal to the ideal of a constitutional monarchy, or the principles of "Wang Tao," which underlie the Oriental conception of Government.

Facts About Manchukuo

A Viewpoint Presented by an American to an Audience of American Business Men in the United States

By GEORGE BRONSON REA, Counsellor to the Government of Manchukuo

Following is an address delivered before the Down Town Association of San Francisco, California, on April 13, 1933.

It is an honor to talk about Far Eastern problems to such a representative and influential gathering of American businessmen. As Counsellor to the Government of Manchukuo, I should try to explain Manchukuo's side of the case, but I prefer to talk to you as one American to another about the problems which vitally affect our own future. Before touching on these matters, I will discharge my duty to Manchukuo in a few words.

You have been told that the new State does not represent the will or the wishes of its people; that millions of Chinese immigrants have settled on its lands and determined the ownership of the soil, until they now comprise 98 per cent of the population; that Manchukuo is a puppet state with the Japanese manipulating the strings. Well, I represent this State, and no Japanese has yet told me what to do or what to say. For the past several months I have been in Geneva where I tried to present Manchukuo's case to the League and, had the League been a Court, it would have had to admit facts which would have changed its attitude toward the new State.

The League sent a Commission of Enquiry to Manchuria to investigate the situation on the ground. This Fact-Finding Body converted itself into the Prosecution which reported its facts to a Grand Jury composed of itself. It then transformed itself into a Court, tried the case *en camera*, delivered its verdict and dissolved itself. Its work was finished.

The Government of Manchukuo sent me to Geneva to present and defend its case before the League, never doubting that this body would act as a Court of Appeal that would admit evidence in rebuttal of the Commission's report. I found, however, on arrival at Geneva, that the evidence was all in. The case was closed. There was no appeal. Manchukuo had been convicted of violating some provision of the Covenant and stood at the bar of justice awaiting the sentence of the Court. The Commission of Enquiry had usurped the authority of the League and its Report was accepted as Holy Writ. I know of no greater travesty on justice.

The Report of An Expert

Now the Commission was accompanied on its visit to Manchuria by a large number of experts. One of these experts was Professor Dorfman of the University of California to whom was confided the task of investigating and reporting on economic conditions in Manchuria. His report was one of the most impartial and valuable documents of the Commission. I am going to quote two paragraphs from his report, published as a Supplementary Document to the Commission's main Report. He says:

> "The author is unacquainted with any instance in recent times where a Government has so ruthlessly, systematically and over so long a period of time exploited and taxed its own people in such a disgraceful manner as have the former Manchurian officials, with the partial exception of those in Liaoning most recently. The disgrace was all the greater because the burden was imposed on those least able to bear it and because practically nothing was given in return for what was taken. In short, it was nothing but monstrous official robbery, the extent and effects of which it is difficult to appreciate" . . . . .
>
> "The Chinese currency situation prevailing in Manchuria on September 18, 1931, was appallingly bad, and stands as irrefutable testimony that the Chinese authorities were guilty of a most heinous offense against the millions of poor struggling humanity over whom they exercised jurisdiction."

These conclusions of an impartial authority tell you why the people of Manchuria seized upon the opportunity created by Japan's resort to self-defense to declare their independence. With this evidence before you, you can readily understand that it required no prodding or urging from Japan to influence the leaders of Manchuria to declare their independence of a government which permitted such oppression on the part of one of its warlords. So much for that point.

Outstanding Facts

When to this basic condition is added the fact that the population of Manchuria is not overwhelmingly Chinese, but overwhelmingly Manchu, that is, Manchurians, you will again understand that they had a legitimate right to determine for themselves their own form of government. This phase of the problem is a study in itself. The time at my disposal does not permit of going too deep into it, but these are the outstanding facts. Exclusive of Japanese, Koreans and foreigners, the population of Manchuria is about 28,000,000, classified as Chinese. We have been told that millions and millions of Chinese immigrants entered and remained in Manchuria during the past two decades until they now constitute the majority of the population. This is not true. At the most liberal estimate, not more than five million Chinese have settled in Manchuria since 1910, or seven million since 1887. Deducting this from 28,000,000 it leaves 21,000,000 to be accounted for. *Who are these people? Where did they come from?*

These people are Manchurians, sons of the soil, born in the state, the legitimate heirs to the patrimony handed down to them intact by their Manchu forbears; a distinct racial group having nothing in common with the people in China proper. When the Manchus conquered China in 1644, they declared their Homeland a Crown Area, the exclusive property of the Throne, the Iron-Capped Princes and the Bannermen. In order to preserve their Homeland from being overrun by an influx of Chinese, the Manchus enacted laws which excluded the Chinese from their territory. This was the first Chinese exclusion law, interesting to the people of California, because it was enforced from the same motives of self-preservation which influenced the people of this State to guard themselves against the same menace.

For nearly three centuries, or up to 1911, the year of the Revolution, these exclusion laws were enforced. No Chinese could enter Manchuria and own land. He could work the land as tenant of the Bannermen, under a permit and passport vised by the Banner Corps Headquarters at Peking. For all practical purposes the regulations governing the entrance of Chinese into Manchuria were equivalent to our own immigration and naturalization laws. When the Chinese passed the frontier barriers into Manchuria, they became legally Manchu subjects, separate and distinct from the Chinese in China Proper. It is true that many Chinese slipped through the barriers, evading the exclusion laws, but they were there illegally, liable at all times to imprisonment or deportation.

In addition to these exclusion laws and in order to keep the blood strain pure, the Manchus prohibited intermarriage between the Bannermen and the Chinese. For nearly three centuries this law was also strictly enforced. Not until 1902 was the edict annulled by the Empress Dowager. In these three centuries of exclusive intermarriage between the Manchu, Mongol and Chinese Bannermen, they evolved a new racial type which although not pure Manchu is certainly not pure Chinese. For want of a better name, they may be called Manchus or Manchurians. There were over 14,000,000 of these people living in Manchuria in 1910 and with their natural increase, added to the three million or so Chinese tenants, they account for the 21,000,000 people which constitute the great majority of the inhabitants of that country. These

people have little or nothing in common with the people of China Proper except the tie of race. Physically, mentally, linguistically and in every other way they are as different from the Southern Chinese as the Nordic is from the Mediterranean type.

These are the people who have asserted their right to self-determination, to rebel against injustice, misrule and oppression, declare their independence of China Proper and set up their own government, a right which no treaties, covenants or other agreements can deny to them.

How A Vacuum was Filled

We are told that we cannot recognize this new state, because it was created as the result of force applied by Japan. Well, what of that ? Japan did not resort to self-defense in order to create the new state. The Japanese army did not invade China for that purpose. The Japanese army was in Manchuria for the protection of their own interests. When the Chinese authorities fled, it left Manchuria without a government. There was a vacuum that had to be filled and the leaders of the downtrodden people hailed the opportunity as one sent by Heaven to escape from their bondage. For them, the end justified the means. They would have accepted help from the devil himself, to get rid of the bandit oligarchy which was bleeding them white. With this very brief explanation of the reason for the existence of the new state, I will now turn to those problems which affect the people of this country. From now on I speak as one American to another.

In the first place, what is our interest in the Far East ? As far as I can gather, it is expressed in the Open Door principle. That is a good doctrine, one we should endeavor to have respected by all other countries. Invariably, whenever there is talk of our mission in the Far East, the American people are told that they must keep the Philippines and maintain a fleet in Asiatic waters for the preservation of our right to trade on terms of equality with other nations in China. Have the American people ever analyzed what the Open Door means ? Reduced to its lowest terms the Open Door means the right to sell our goods to China, not to buy Chinese agricultural products which compete with those of our own farmers. Now, if we examine the statistics of our exports to China over a period of years, we will find that a fair average is about $100,000,000. We will also find that fifty to sixty percent of this trade is in oil and tobacco, a natural monopoly, which, for the present, nobody can take away from us. Some day Russia will edge in on our oil business and the Chinese will grow their own tobacco. Japan has no oil and grows no tobacco worth smoking. For the present, we do not have to go to war with any nation to hold this trade.

Now, I am going to tell you something you don't know. Twenty-five to thirty per cent of our export trade with China is what the Japanese purchase in this country for their own enterprises in China. Japan has about $500,000,000 invested in railways, mines, cotton mills and other industrial enterprises in China, which creates a market of about $50,000,000 a year for supplies, spare parts, extensions, accessories, raw materials, etc. A large part of these requirements are purchased in this country. In some years these purchases exceed $40,000,000 but I am taking the lowest figure as the average. It is easily $30,000,000 a year.

More Trade Figures

This appears in our trade returns as American exports to China. Ostensibly it is Chinese business. In reality, it is Japanese and no one can take it away from them. So here we have fifty per cent oil and tobacco, an American monopoly, and twenty-five to thirty per cent which the Japanese buy from us, leaving twenty-five per cent in sundries. The Open Door Doctrine, expressed in dollars and cents, means that we must fight to hold a trade of twenty-five million dollars.

But this is not all. There is still another side to this interesting problem. The Japanese also purchase American raw and partly finished materials to the value of $50,000,000, manufacture them into finished products and export them to China. This appears on the Chinese trade returns as imports from Japan. So, with the twenty-five million dollars worth of American materials purchased for Japanese enterprises in China and the fifty million dollars worth of American raw products exported to Japan destined for the Chinese market, we have a total of $75,000,000 worth of American products which are sold by the Japanese in the Chinese market, equivalent to the gross American trade in all commodities. The Japanese sell as much American goods in China as we do ourselves. When the Chinese boycott Japanese goods, American trade may benefit in China, but our exports to Japan fall off in proportion.

Now what is a fair profit from our $100,000,000 export trade with China ? Let us put it at ten per cent. Most of the American firms I know in the Orient are so deep in the red that they would hail with joy the prospect of making even half this profit. But let us assume that we are making $10,000,000 a year out of our Chinese export business. That sounds good. But turn to the other side of the ledger. My figures are subject to revision, but five or six years ago, we were spending ten million dollars in missionary work, with another four or five millions in colleges, hospitals, Y.M.C.A.'s, Rockefeller Institute and other philanthropies. The total is now much less, perhaps one-half. But for a long period, the statement holds good that for every dollar of profit that came into the country from its export trade with China, we handed back one and a half for charity and uplift work. I am not criticizing this. I am merely stating a fact.

I do not know what it costs our Government to maintain the Asiatic fleet, the Yangtze Patrol, the two Marine and the Regular Army Regiments stationed in China for the protection of American lives and properties, but it will fall not short of $15,000,000. Add to this the direct and indirect subsidies to American shipping in the Pacific. Red Cross famine and flood relief, Boxer Indemnity refund, default on loans and payments for materials delivered, and you will find that we are in the red so deep that it will take us decades of preferred and profitable trading to balance the account.

U.S.A. Colony of Canton

Let us go still further into this subject. There are supposed to be some 60,000 Chinese legally residing in the United States and according to the American Commercial Attaché in Shanghai, they remit to China annually the sum of $25,000,000 gold ! This, of course, represents only a part of their savings. The total must be much greater. We have no way of arriving at a correct estimate, but five years ago, the Chief of Police of New York City said that there were over 700 Chinese restaurants in Greater New York alone and their gross intake was about $75,000,000 a year. Now every city in the country has its quota of Chinese restaurants, so it is fair to assume that their gross business is four times that of New York City, or say, $300,000,000. Add to this, the receipts from all their other activities and it is a safe estimate that the Chinese in the United States are doing a business of over $400,000,-000 a year with profits corresponding to the nature of the business. If they remit $25,000,000 a year to China, their total profits must be near $100,000,000. America is the preferred economic colony of Canton. Again, this statement is not a criticism. I merely state the fact.

These are the figures you must keep in mind when you are told that we must build up a navy and be prepared to fight for the Open Door in China. We could then add in the red ink column the cost of that war and wonder what it was all about. Eventually, we will have to pay for the Great War and all we need to shove us into bankruptcy is a war in the Pacific over the Open Door principle, the integrity of China, the Sanctity of Treaties, or some other slogan that will again send our boys out to the slaughter.

I am a great friend of the Chinese people. I sympathize with them in their problems and have done as much, if not more, than any other American to help them in their difficulties. At various times, I have been adviser to the Chinese Government and have a keen appreciation of what they have to contend against. However I am first and always an American, and when I became convinced that their diplomacy and propaganda would involve the United States and Japan in a war in the Pacific, I could no longer support them. I reluctantly and sorrowfully gave up my career with the Chinese. For the past ten years I have devoted my energies towards bringing about a better understanding between the United States and Japan, and to do this I have had to explain Japan's viewpoint. With all my sympathy for China, I can see no good reason why your boys and mine should fight Japan for the sake of 500,000,000 sturdy pacifists who will not fight for themselves and whose disorganization invites the conflict.

I have no illusions about Japan. I react to her problems the same as I would if my own country was up against the same difficulties. I know her needs, I understand and sympathize with what her so-called militarists have set out to accomplish. We Americans would do the same, only we would not have waited so long, nor would we have attempted to justify our actions before the world. Human nature is very much the same the world over. It is a good thing for somebody that the Western limit of the American continent is the Pacific Ocean. Otherwise, the old 49'ers and those grandfathers of ours who wrested the West from the Indians and converted the wilderness into a paradise, would still be marching on towards the Setting Sun, looking for more lands to conquer.

The same spirit of conquest, the same urge for new lands animates the Russians. No government can control this natural movement of a people. We have only to remember our own history to understand the urge of a similar land-hungry people steadily pushing their frontiers deeper into the Asiatic continent. And, when we grasp this essential point, we can understand the anxiety and apprehension of the Japanese people that some day they will once more have to stake their existence on the plains of Manchuria.

The Soviet Domain in China

Mongolia to-day is a Soviet Republic. Chinese Turkestan is economically a part of the Soviet system. Central China is a congery of Soviet Republics. Northern Manchuria is, or was, a Soviet sphere of influence. China is slowly turning Red. It is only a question of time when she will become another Soviet Republic. This is the menace that confronts Japan. This is what the Japanese army is fighting against, defending themselves while there is yet time to do so. Had they waited another year or so, until Russia had carried out her program, it would have been too late. Japan was caught with her back against the wall, her feet held fast in a treaty trap, while the Chinese had thrown a noose around her neck and were slowly strangling her to death. Do you wonder that the Japanese made a desperate attempt to free themselves ?

We are told that Japan has broken certain treaties, that she must be outlawed and made to feel the weight of our honest indignation. We are told that we cannot forgive her until she confesses her guilt and makes restitution. But Japan insists that she has broken no treaties ; she says she acted solely in self-defense—a right that all nations reserve to themselves, especially our own country. We have constituted ourselves into judges of Japan and condemned her for violating treaties signed with this country. We place our treaties above the law of self-preservation of another nation. From our viewpoint, we are right, but the Japanese are also right.

What are we going to do about it ? Will we fight Japan ? Will we boycott Japanese goods, and declare a blockade of Japanese ports ? That means war ! Will we insist that Japan is a treaty-breaker and marshal world opinion against her ? Will we keep on calling her names, pinpricking a proud people to the point where they become enraged and commit some act that will precipitate hostilities ? Under such conditions, some overwrought Japanese may throw a bomb into the American Embassy or some of our Consulates ; they may kill a few Americans, or blow up an American ship. The fat would then be in the fire.

Japan has many reasons to be apprehensive of American policy in the Orient. I will confine myself to one phase of it. We have barred the Japanese out of our country. Canada, New Zealand, Australia and other British dominions have followed our example. The Japanese cannot go into China and own or lease land. They have a temporary outlet in South America, but how long will this remain open to them ? There is only one over-flow for their rapidly mounting people, and that is in Manchuria. If, after excluding the Japanese from this country, we follow them up in Asia and build a ring fence around them, we must make up our minds that some day we will have to fight Japan.

A Question of Biology

We cannot control the tremendous human forces at work in Asia. No war can stop the natural increase of these peoples. Japan's population is increasing at the rate of nearly a million a year. In ten years there will be a hundred million people in the Japanese empire ; in 25 years one hundred and twenty million. Look beyond to China, with over five hundred million people. They keep no statistics. We can only guess at their rate of increase. Let us assume that they are doubling their numbers in a hundred years. In twenty years there will be another hundred million Chinese. Beyond China lies Russia with a population of one hundred and seventy-five million, doubling its numbers in 45 years. In 20 years there will be 80 million more Slavs. Where will all these people go ? They cannot come this way, so they must seek their outlet in Asia.

We say, in effect, to the Japanese : you cannot go into Asia, you have signed treaties with us to respect the sovereignty and integrity of China. If you break these treaties, we will hold you to account. But we have no treaty with Russia. Russia can do as she pleases in Asia. Russia is not even a member of the League. She can slice off huge chunks of Chinese territory ; she can enter into alliances with Chinese political parties ; she can send her agents to stir up revolutions in China, and get away with it. Whatever Russia does seems to be all right with us. Japan may not defend herself against this menace without violating the Covenant, the Nine Power Treaty or the Kellogg Pact and arousing the hostility of the rest of the world. This, in effect, is the situation that confronts us in the Orient.

What are we going to do about it ? Suppose we went to war with Japan over these matters ? Let us assume that we emerged victorious from such a war. What would we have accomplished ? We might kill a million Japanese, but in another year there would be a million more to take their place. If victorious, we would have to maintain a huge fleet in Asiatic waters to enforce the peace terms. The cost of enforcing the treaty would be greater than the cost of the war. What then would we gain from a war with Japan ? American commerce in the Pacific would be destroyed. Japan would be bankrupt and set back for a generation, while the trade and development of China would go to our competitors in Europe. Perhaps you will now understand why some people are always talking about the inevitability of a war between the United States and Japan. The wish is father to the thought. If we emerge victorious from such a war, we would lose our best customer in Asia, and we would then probably lend her a few billion dollars to get on her feet again, as we did with Germany.

War between the United States and Japan is absurd. At present, under the ratio of the Naval Treaty, such a war is a physical impossibility. We would need a navy three times larger than Japan's to assume the offensive. Japan would take the Philippines over night and it would take us two years or more to get them back. If we should ever drift into a war with Japan we would have to sit tight until we built up a new navy ; a two years' job, at least. Assuming that we won the war, what would we get out of it ? If we win, we lose.

Course the U.S. Should Follow

If we cannot stop Japan, why should we make her our enemy by calling her names, marshalling world opinion against her, and doing our best to outlaw her in the family of nations. It is time for Americans to ponder over these matters.

We cannot stop Japan. We should make friends with her, try to understand her problems, and co-operate with her in their solution. For our own future security, we should do our utmost to assist Japan in finding an outlet for her people in Manchuria and Mongolia. There the expanding Japanese will meet the expanding Slav, and the issue of the races will be settled on the plains of Central Asia where it belongs, and not in the Pacific.

If, however, we place ourselves across the path of Japan ; if we insist that the integrity of China has, like the Monroe doctrine, become a cardinal feature of American policy ; if we stop this pressure from finding an outlet in Asia, then we must make up our minds that some day we must fight Japan. If that is to be our policy, I have only this to say. In the lifetime of the present generation the pressure of population in the Orient will precipitate the issue. If it cannot overflow into Asia, it will seek an outlet across the Pacific. There is just one thing for us to do. Dig the Nicaragua Canal ; fortify the Panama Canal Zone ; convert Hawaii into an impregnable naval base ; build up our fleet to the treaty limit, and then some ; make ourselves supreme in the air ; strengthen

(Continued on page 220)

Railway Construction Pushed by Manchukuo*

Taian-Koshan-Tungpei-Hailun Line and Link Between Tunhua and Korea to be Ready for Operation in Time to Handle Autumn Crops

By CHOKIURO KADONO, Vice-President, Okura & Company

RAILWAY progress in Manchuria, already much more notable than that of China, is continuing. Last year new construction was pushed forward and much of what was undertaken will see completion in 1933. Again, all state lines taken over from the old régime were placed under the control of the Manchukuo Central Railway Bureau, with head office at Mukden, and the management of the South Manchuria Railway.

Perhaps the most important railway development this year will be the opening to traffic of the Changchun-Kirin-Tunhua-Yuki line, which will serve as an artery for the flow of produce and passengers between northern Manchukuo and the Japan Sea. The northern section of Manchukuo cannot be compared with the south. It is incomparably better in both quality of soil and abundance of water. There is no richer valley in the world than the water shed of the great Nonni River, which will be tapped both by the Chinese Eastern Railway and the State lines leading to the Japan Sea. It will be an interesting study to watch the growth of this part of the Asiatic continent with the energetic assistance of Japan.

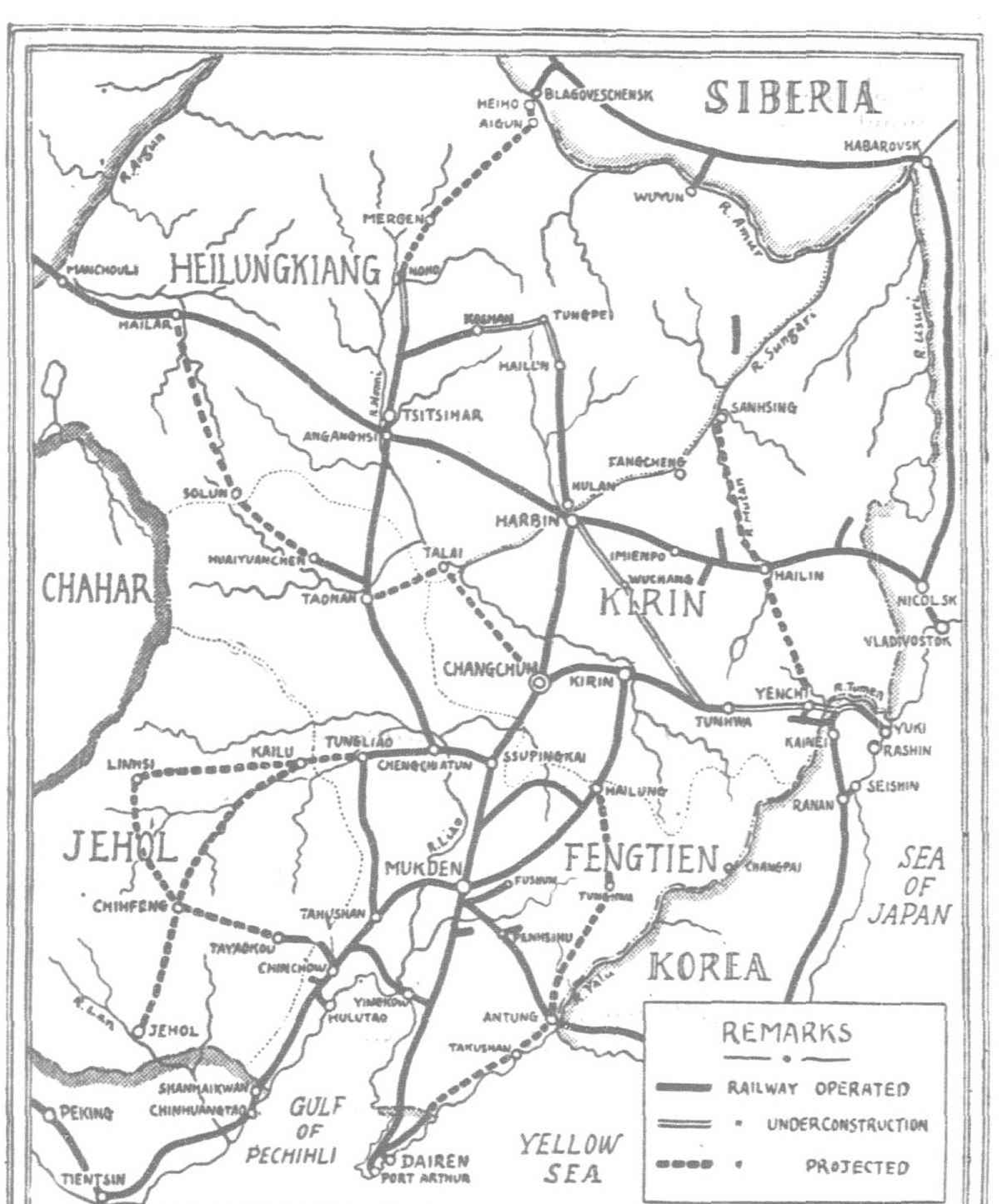
Railway construction between April, 1932, and April, 1933, was fairly active in North Manchuria. Work progressed on lines connecting the cities of Taian, Koshan, Tungpei and Hailun, about 150 miles in all. This link has been practically completed and may be in operation by the summer. A line branching off from Ningnien on the Tsitsihar-Taian road, some 25 miles in length, is graded and may be open for traffic at the same time. These 175 miles are the sum total of new railway construction in north-western Manchuria.

But the 120 mile strip connecting Tunhua with the Korean border will be ready by the summer, in time to handle the heavy crop movements of the fall.

Some work has been done on the line between Harbin and Tunhua by way of Wuchang during the past year but only a little progress has been made, due to the heavy nature of the country.

May Build in Jehol

So far there is no definite indication which of the other projected lines will be taken up during the coming season. But it is natural that, after the events in Jehol of the past few months, some railway construction there will be undertaken. Whether the building will be westward from Tungliao on the Chengchiatun-Tung-liao-Takushan line or whether there will be an extension of the Chinchow-Peipiao line into the heart of the province so far has not been announced. It may be that both will be undertaken, although building will consume much more time than a year or two.



The Railways of Manchukuo

In Manchuria only half a year, from April to October, is fit for outdoor building work. This inclement climate retards the speed of construction by 50 per cent when compared with milder climates such as Japan. This is also the case in house building. Changchun, the new capital, has been unable to house its increasing population, as no building work can be attempted from late autumn to late spring.

There will no doubt be great building activity in the new capital during the summer, as great preparations have been made and the required materials have been accumulated during the off months.

The most interesting event in the Manchurian railway world has been the establishment of central management for the Manchukuo State Railways. Management is in the hands of the South Manchuria Railway, under the supervision of the Manchukuo Government. These state lines cover 2,150 miles which originally were under eight different managements, nominally more or less controlled by a central authority but actually each and all pulling in different directions.

This has all been changed and a central and single authority called the General Railway Bureau has been opened in Mukden with Mr. Usami as its chief to operate and manage all the state-owned lines. This bureau will co-operate with the South Manchuria Railway in all important operating and tariff arrangements. The state-owned lines occupy a most imposing position. In length they cover three times the length of the South Manchuria Railway lines. The two systems can co-operate and complement each other.

International Connections

The third system is the Chinese Eastern Railway (now called the North Manchuria Railway). Taken together, the three systems have important international connections. The most important of these are:

(1) Dairen-Harbin-Manchuli, to connect with Trans-Siberian trains for U.S.S.R. and Western Europe.

(2) Korean-Antung-Mukden, to connect with the South Manchuria main line at Mukden.

(3) Yuki (Rashin), Korea-Tunhua-Kirin, to connect with the South Manchuria Railway main line at Changchun.

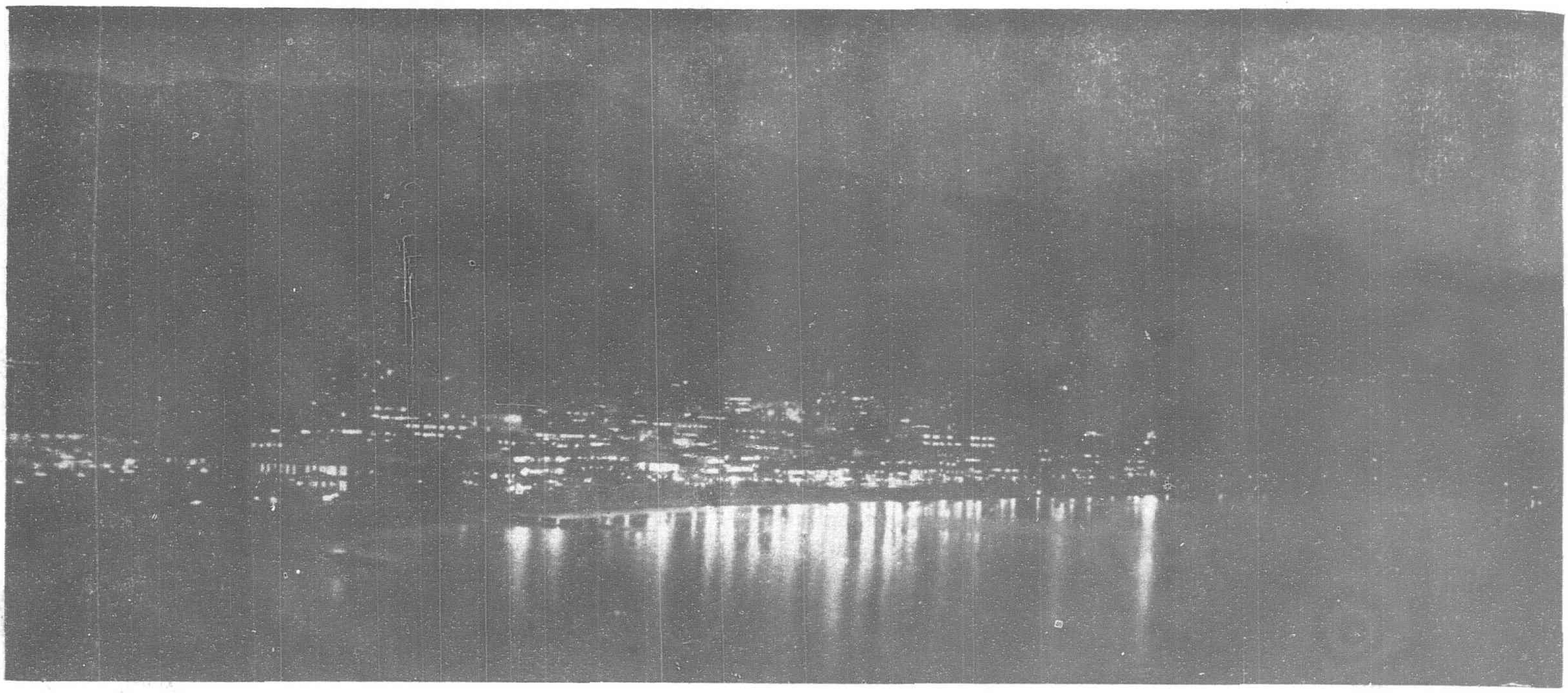
(4) Mukden-Shanhaikwan, to connect with the Chinese Government Railways for Tientsin and Peiping.

(5) Vladivostok-Harbin-Manchuli and Europe.

These are the lines which are of importance because of international connections. With these main thoroughfares and with the seaports of Dairen and Yuki (Rashin) in view, the flow of

(*Continued on page 239*).

* *Japan Advertiser Annual Review.*



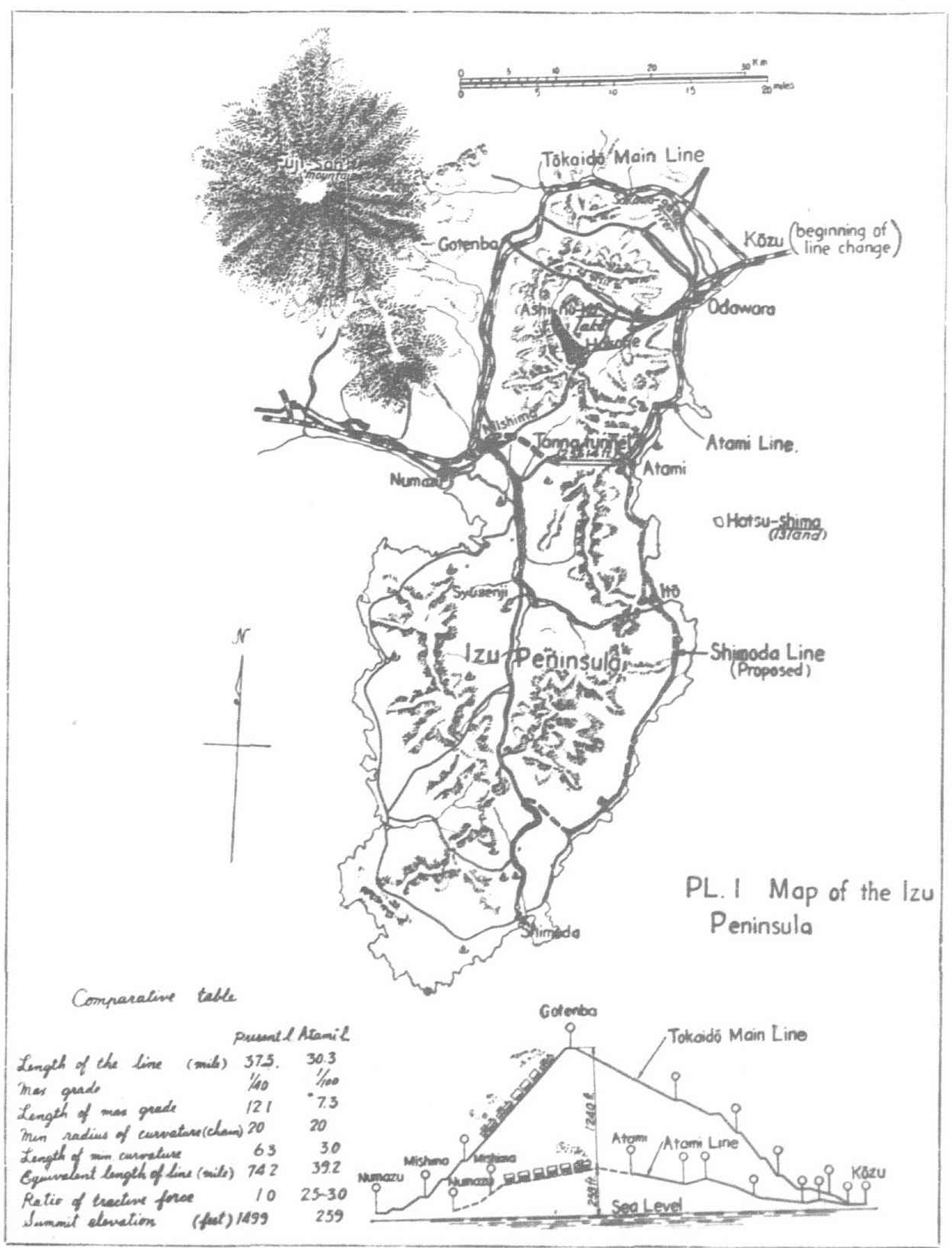
Atami Spa at dusk . . . Its scintillant canopy of man-made lights gleaming into the darksome depths of Sagami Bay . . . the muted echoes of its passing life wafted upward 'gainst the rugged crags of a crescent ridge 'neath which is bored the Tanna Tunnel

The Tanna Tunnel

By W. HARVEY CLARKE, JR.

OUTSTANDING in the annals of engineering, the epic struggle over a decade and a half of men working underground against relentless forces of nature to bore the Tanna Tunnel in central Japan, at length is nearing completion. In the difficulties encountered and surmounted this great enterprise undoubtedly stands unique in the history of railway tunnel construction and the description of this work cannot fail to engage the interest of engineers all over the world. Fifteen years ago, on April 1, 1918, manual digging operations were begun at Atami spa at the east portal of the tunnel, which is to run 25,614 feet (4.86 miles) through and beneath Takiji peak on the Izu Peninsula. On July 6, 1918, ground was broken at the west portal near the village of Otake, seven and a third miles north-east of Numazu on the sea. Early this spring the main headings lacked less than 880 feet of meeting half way between the two portals.

Original specifications called for 180-ft. of progress every 30 days, with an approximate date for completion seven years from the time work commenced. But to impede work, a series of unforeseen obstacles arose, in consequence of which this limit was advanced first to 1929 and again to midsummer of 1934. An initial estimate of close to Y.65,000,000 is expected to run considerably short of defraying total construction costs—for excavation and lining throughout the years intervening since 1918 have been fraught with delays and tremendous difficulties such as seldom have been experienced elsewhere in driving one of the longest tunnels of the world.

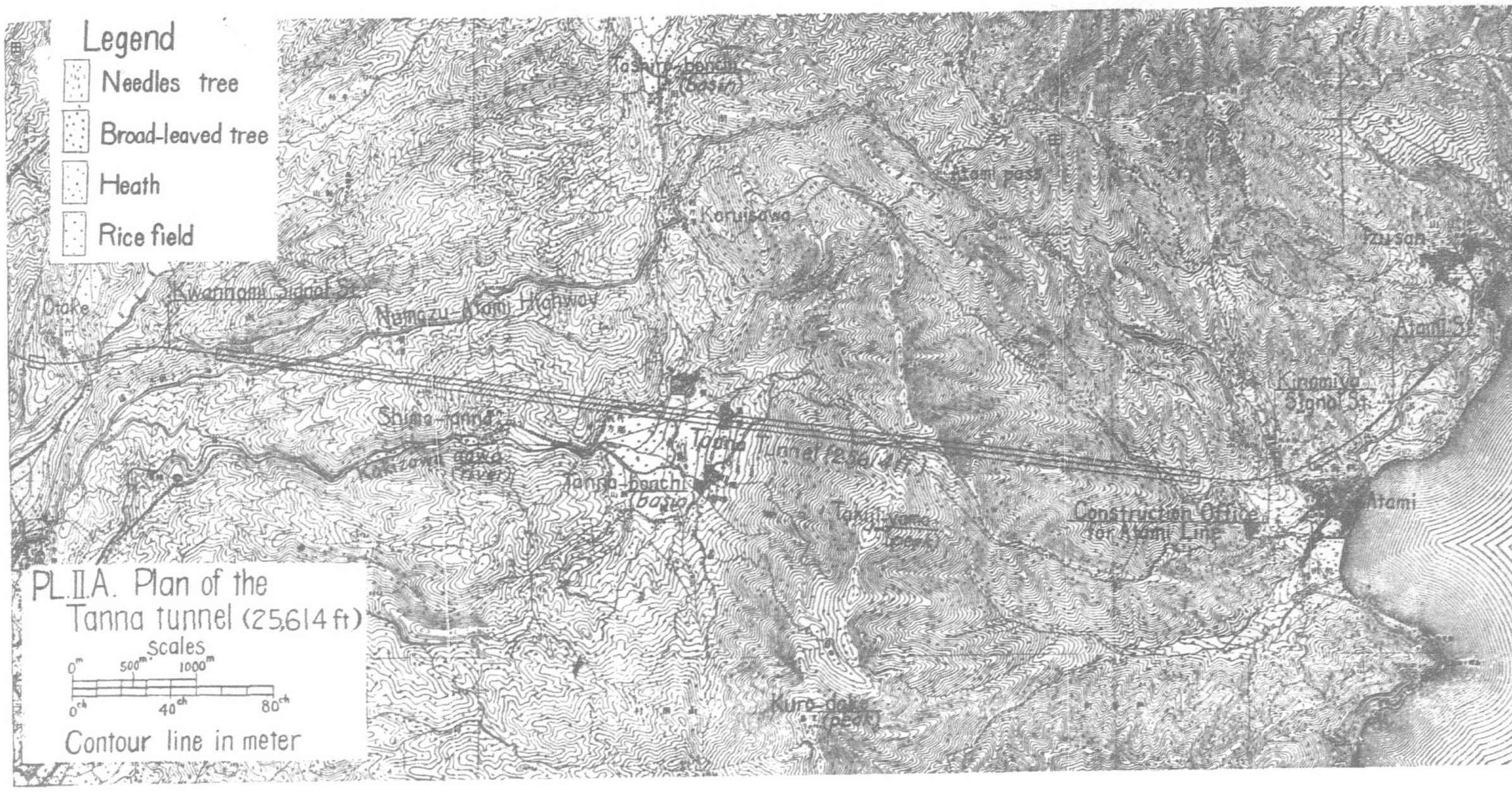


PL. I Map of the Izu Peninsula

Among the world's railway tunnels, the Tanna claims ninth place in length, and in Japan comes second to the six mile Shimidzu bore, which, however, has only a single-track roadbed completed in September, 1931.

In combating volcanic lapilli, successions of faults, soft clay, swelling ground and an enormous waterflow at high pressure, varied methods of tunneling have been applied. Compressed air with small shield and lining segments, cementation or high pressure cement grouting and miles of driftways, run for drainage by-passes, were resorted to successfully, although often times entailing much toilful exertion and discouragingly slow progress. Because of multiple hazards stalking the labor of construction during a decade and a half, 65 men already have lost their lives ; 16 workers at once were buried or drowned on two different occasions. Then, five men, only two of them rescued, were buried by a cave-in on November 26, 1930, at 4.30 a.m., when the west heading was 10,800-ft. from the portal during the severe Izu earthquake.

Constituting a vital link in a 30.3 mile cut-off for the Tokaido



PL.II.A. Plan of the Tanna tunnel (25,614 ft)

trunk line of the government railway system between Tokyo and Kobe, the Tanna tunnel provides for a 3½-ft. gage, double-tracked right-of-way on the new Atami line. It will render obsolescent—but for branch-line accommodation—the present 37.5 mile Kozu-Numazu section hurdling Hakone pass with its 1,500-ft. elevation and a steady 2.5 per cent gradient. This heavy-graded route not only limits main-line traffic movement but, in skirting the Sakawa River, it is seasonally endangered by washouts and landslips.

The Atami cut-off, on the other hand, maintains the railway bureau's ruling grade of 1 per cent and curves of 1,320-ft. radius (about 4 deg., 20 min.); yet in its construction no less than 23 tunnels and 72 bridges have had to be provided along a 30-mile course. As against the 1,500-ft. rise to Gotemba in the mountain pass, an altitude of only 259-ft. is reached within the Tanna tunnel. After it is opened for service, fast trains will shorten by some 30 minutes the running time between Kozu and Numazu, while officials predict at least a trebled traffic volume for the Tokaido.

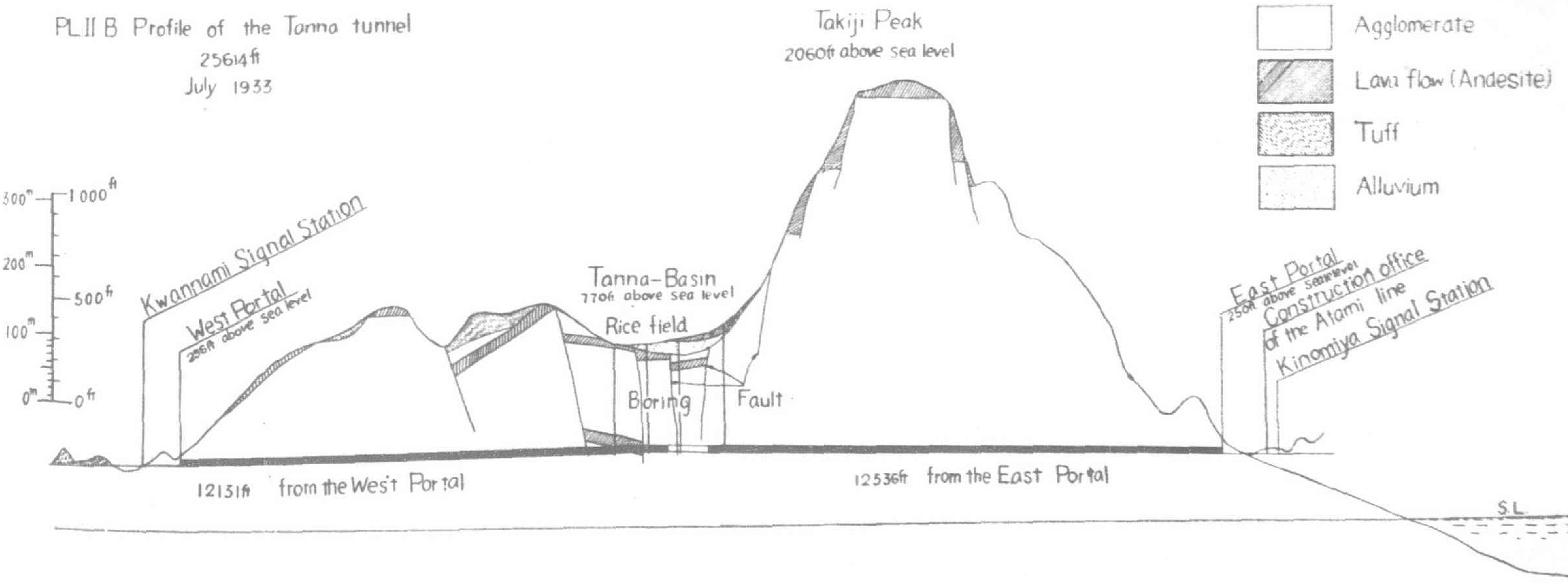
Geology of Region.—Crescent-shaped Sagami Bay, sheltering Atami, corresponds to the depression crater of a volcanic cinder cone of prehistoric date, and Takiji peak, rising west of the town, as well as the island of Hatsushima off from its coast are part of the ancient outer-crater wall, geological opinion has declared. Continual evidence brought to light substantiated the supposition that the character of subterranean formations factually indicate a volcanic cinder cone origin. From the crater itself to the skirt of the one-time volcano, the tunnel passes directly through the depression crater—from its dip and strike lying in a general east to west direction.

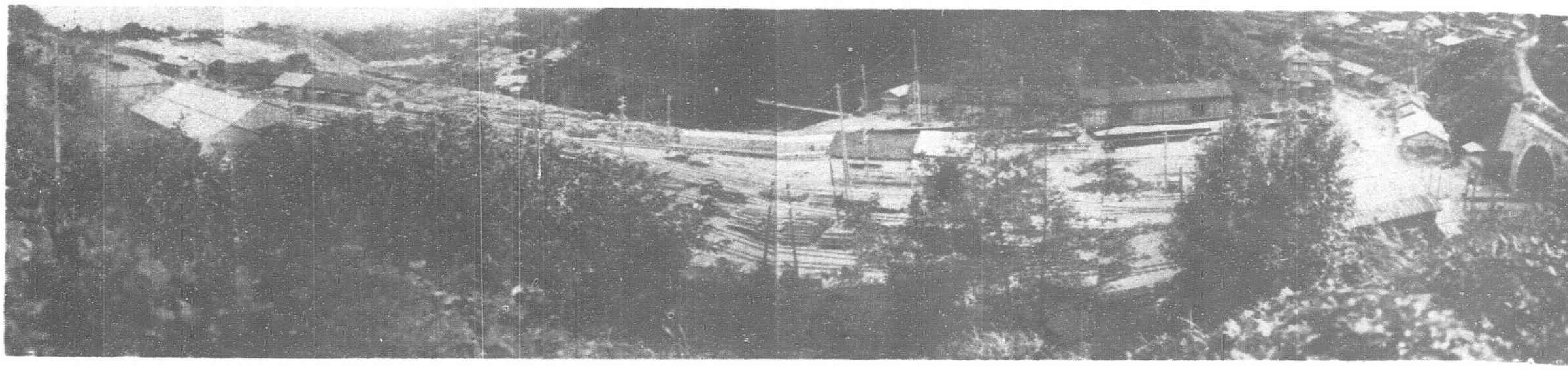
Designed to penetrate the narrow mid-part of the Izu peninsula at a point about 60 miles south-west of Tokyo, excavation of the tunnel has proceeded through the heart of a region abounding in mountains riven subterraneously by frequent intercalations of fractured strata composed of friction-breccia or detrital fault-rock, vast underground beds of agglomerate with interfluent veins of scoriaceous and vesiculate lava, and intrusive pockets of basaltic andesite, as well as soft solfataric clay—all attesting to extinct if not dormant or waning volcanic action. The peninsula therefore is still subject to recurring earthquakes of more than common intensity.

Under the Tanna Basin

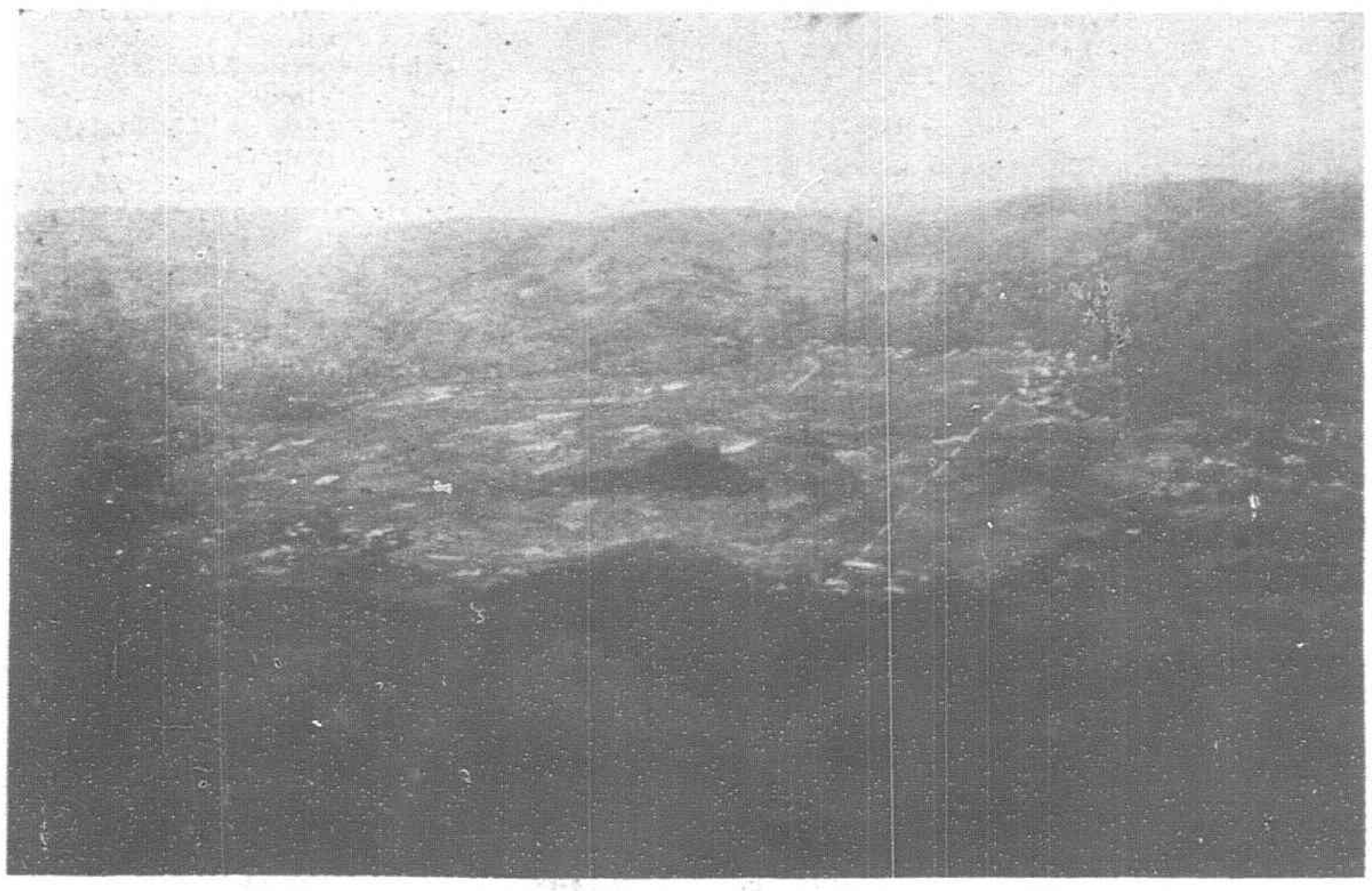
Representing a settlement of faulted ground, there is a circular depression known as Tanna basin—1.3 miles across and 770-ft. above sea level—about midway of the highland under which the tunnel is driven. This basin was formed by displacements of strata and, judging by test borings made in 1925, it was in some bygone age the bed of an ancient lake. The basin-floor definitely shows stratified lacustrine depositions such as silt, peat and other alluvium; its fertility is evidenced by the existence of two agricultural communities deriving their livelihood from the soil. In order

PL.II B Profile of the Tanna tunnel 25614ft July 1933



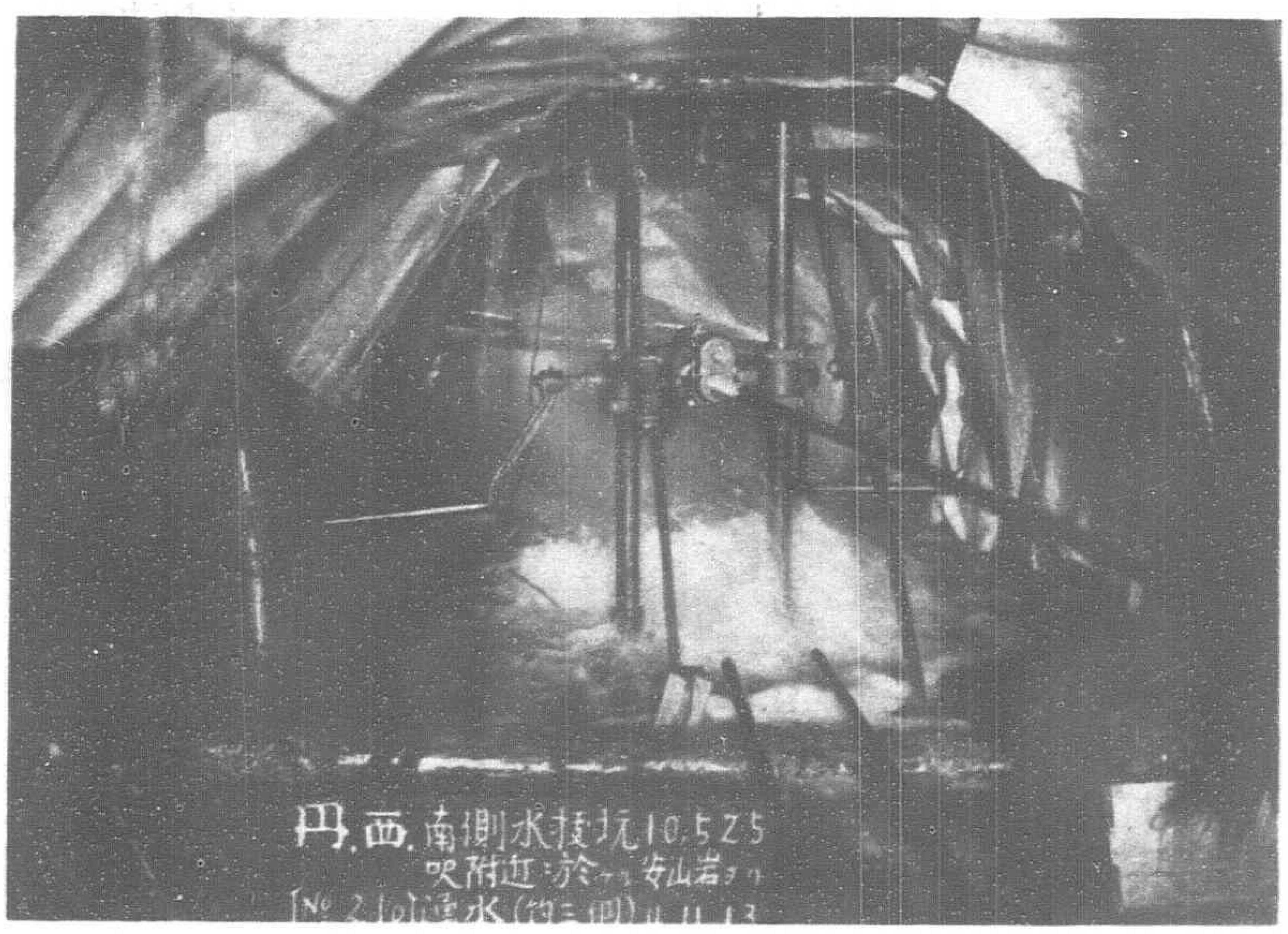


Panoramic view of approach to East Portal of Tanna Tunnel, Atami, with District Offices, Turbo-Generator Compressor Plant and other construction camp facilities

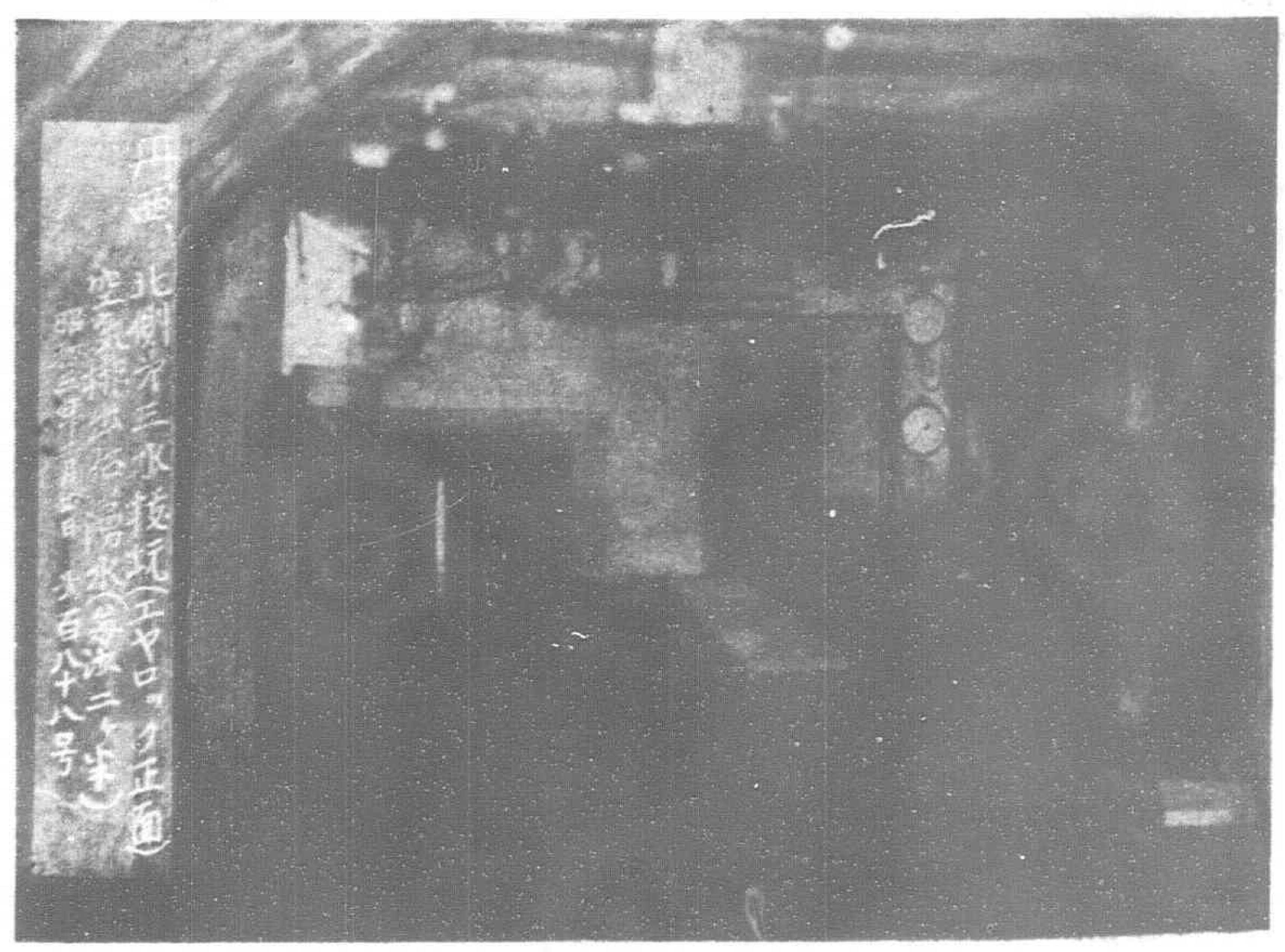


Encircled by a lofty ridge, Tanna Basin, 1.3 miles across at 770-ft. elevation; a Faulted Depression of fertile Alluvium evidencing Stratified Lacustrine Depositions; Tunnel is bored about 500-ft. under broken white line

Bird's eye view of Otake Camp, showing Valley Formation at West approach to Tunnel-Mouth and, in foreground, Turbo-Generator Electric Power Plant, November 28, 1929



At rate of 3 sec. ft., Water flowed into Right Driftway, where test holes were bored, 10,525-ft. from West portal, November 13, 1929



Compressed-Air Lock Equipment in Drainage Tunnel on West Side, February 4, 1928

to ascertain more about the inner formation of the basin and to determine future methods for tunneling beneath it, the ground surface was explored again by drill holes completed in August, 1926. These experimental borings revealed that Tanna basin, corresponding to a kettle depression produced by a group of faults, lies athwart a long broken line running north to south. Consequently, a tunnel driven under the depression would inevitably encounter many faults and seams.

The course of the tunnel being in a volcanic zone—the east end near Atami spa in particular—rock temperatures of 82 to 138 deg. F. beneath Takiji peak were predicted, but the maximum has been 82 deg. at 4,300-ft. from the east portal, with high humidity fatiguing to workmen. Inrushes of water caused this temperature to fall to 61 deg. A spring of 97 deg. F. was struck at 900-ft. from the east portal, but the flow soon failed, and its temperature was not taken after the tunnel-head was advanced to 6,000-ft.

Certain fault zones, frequently a source of accident when intruded by water-bearing pockets, were filled with soft clay, loose rocks, gravel and sand—known as friction-breccia—sometimes 40 to 50-ft. thick. Agglomerate and andesite were plentiful, the former often composed of volcanic lapilli rock-forming minerals, thus making the soft areas porus and permeable to water.

At high pressure big volumes of water were tapped in spacious cavities in line with and above the tunnel, reaching a maximum

flow of 123 sec. ft. at the west side on May 8, 1925. A veritable deluge has continued to flow out of the tunnel-mouths. In July, 1929, the discharge from each portal was about 35 sec. ft.; to-day the west side flow reaches 37 sec. ft., with only 24 sec. ft. under a pressure of 90-in lbs. at the east side.

In water-bearing strata on the east side in 1926, many faults impervious to water obstructed its free flow, thereby raising high pressures up to 275-in. lbs. When the heading pierced these faults workers were engulfed by torrents of water with fault-breccia streaming out in a mud flow. In one instance drill and operator were thrown some 15-ft. from the heading when the rod broke through into a water pocket.

Continuous volumes of water having been drained away through the tunnel structure, the ground-water table was lowered in its vicinity. Springs and wells failed and fields sank. In Tanna basin the seepage zone went virtually dry.

Solfataric clay, which has been a source of much grief, is formed by detrition of rock through the action of hot springs and stream jets or fumaroles venting through faults and fissures. This clay, resembling rock when unearthed, begins to swell and requires heavy support. In absorbing water it suddenly flows in a mud stream.

Except the 8,060-ft. Izumigo tunnel, all others on the new Atami line are double-tracked. Lining thicknesses of the tunnel structures vary with the intensity of ground pressure upon them. The minimum thickness of the lining is 28-in. (2-ft., 4-in.) at the crown of the arch, and the maximum reaches 75-in (6-ft., 3-in.) along wall sections and at the base. These measurements point to an exceptionally high ground pressure which is not a serious factor in railway tunneling in Europe or America. At the springing-line the Tanna tunnel is 28-ft. wide and rises to 22½-ft. above subgrade. The semi-circular arch has a radius of 14-ft.

Timbering.—Unbarked, green pine logs, about 15-ft. long by 15-in. in diameter, are used for timbering. These dimensions have proved satisfactory in durability, weight and cost. The logs are cut to serve various purposes such as props, posts, bars and sills. Joints are held mostly by cramp and dog irons, neither bolts nor square timber being used. But for the main headings, which could be left untimbered temporarily, immediate timbering of all excavated surfaces is carried out. Steel frames and monolithic concrete are necessary in some parts of the headings.

All operating equipment was installed by August, 1919, excepting low pressure compressors and a hospital lock for compressed-air excavation. Steam power at first drove compressors, but, when transmission equipment was available, electric power was employed. With no private company to supply current, an isolated generating plant was put in at the west end camp. Later, however, power was gotten from such companies at lower cost, so this plant was operated only when current from two different sources was needed for safety of the work.

TABLE I.

PRINCIPAL SURFACE EQUIPMENT AND PLANT FACILITIES

East (Atami) End	*West (Otake) End*
AIR COMPRESSORS:	AIR COMPRESSORS:
3 Horizontal, 2-stage air compressors for 867 min. ft. at 100-in. lbs. 1 Horizontal, 2-stage air compressor for 446 min. ft. at 100-in. lbs.	3 Horizontal, 2-stage air compressors for 867 min. ft. at 100-in. lbs. 3 Rotary, low pressure, single-stage air compressors for 1,270 min. ft. at 50-in. lbs.
VENTILATING FANS:	VENTILATING FANS:
2 5-stage, horizontal turbo-blowers for 5,000 min. ft. at 5-in. lbs.	2 Horizontal, extra-heavy type gas exhaust for 5,000 min. ft. at 1.5-in. lbs.
ELECTRIC LOCOMOTIVES: GAGE, 2′–6″.	ELECTRIC LOCOMOTIVES: GAGE, 2′–6″.
Trolley-Wire Locomotives:	Trolley-Wire Locomotives:
2 9 ton, center cab, 4-wheel elec. loco. of 4,000 lb. tractive force at 7 mi./hr. 1 6 ton, side cab, 4-wheel elec. loco. of 3,500 lb. tractive force at 6 mi./hr.	2 9 ton, center cab, 4-wheel elec. loco. of 4,000 lb. tractive force at 7 mi./hr. 1 6 ton, side cab, 4-wheel elec. loco. of 3,500 lb. tractive force at 6 mi./hr. 1 6 ton, side cab, 4-wheel elec. loco. of 1,000 lb. tractive force at 7 mi./hr.
BATTERY LOCOMOTIVES:	BATTERY LOCOMOTIVES:
2 4 ton, side cab, 4-wheel battery loco. of 1,500 lb. tractive force at 3.5 mi./hr.	2 4 ton, side cab, 4-wheel battery loco. of 1,500 lb. tractive force at 3.5 mi./hr.
ROTARY CONVERTERS:	ROTARY CONVERTERS:
2 3-phase, 6-pole rotary converters; 100 kw., 50-cycle, for a.c. 380-volts and D.C. 600-volts.	2 3-phase, 6-pole rotary converters; 100 kw., 50-cycle, for a.c. 380-volts and D.C. 600-volts.
	OTAKE STEAM POWER PLANT: Output: 3,000 kva. Steam boilers: 4 400 h.p., water-tube boilers with superheater for 190-in. lbs. by gage. Steam Turbine: 1 horizontal, 400 h.p., Parsons Reaction turbine; speed 3,000 r.p.m.
REPAIR SHOP FACILITIES:	REPAIR SHOP FACILITIES:
2 8-ft. English pattern engine lathes. 1 4-ft. ,, ,, ,, lathe. 1 20-in. drilling machine. 1 22-in., plain milling machine. 1 24-in., back-geared shaping machine. 1 ¼ × 1¼-in. bolt-screwing machine, etc.	2 8-ft. English pattern engine lathes. 1 6-ft. ,, ,, ,, lathe. 1 4-ft. ,, ,, ,, ,, 1 20-in. drilling machine. 1 22-in. milling machine. 1 24-in., back-geared shaping machine. 1 ¼ × 1¼-in. bolt-screwing machine, etc.

Ordinarily the so-called New Austrian system has been followed as most feasible for the Tanna tunnel, the bottom heading being excavated first at subgrade and enlargement coming next. After excavation, lining concrete is poured or laid with concrete blocks. Side wall surfaces in most places are set with poured concrete and the arch section lined with precast monolithic concrete. Special methods were adopted for unstable ground and heavy earth pressure, unable to be withstood by the above method alone. Plate IV illustrates one of these termed the German method, also details of the usual stages of excavation, timbering, etc.

Typical Tunneling Procedure.—In driving through ordinary ground, a bottom tunnel-head, measuring 12-ft. by 9-ft., is excavated, with a rectangular ditch or drain covered over with concrete slabs in the middle of the floor, which is at formation level. At intervals vertical shaft are driven upward to the roof

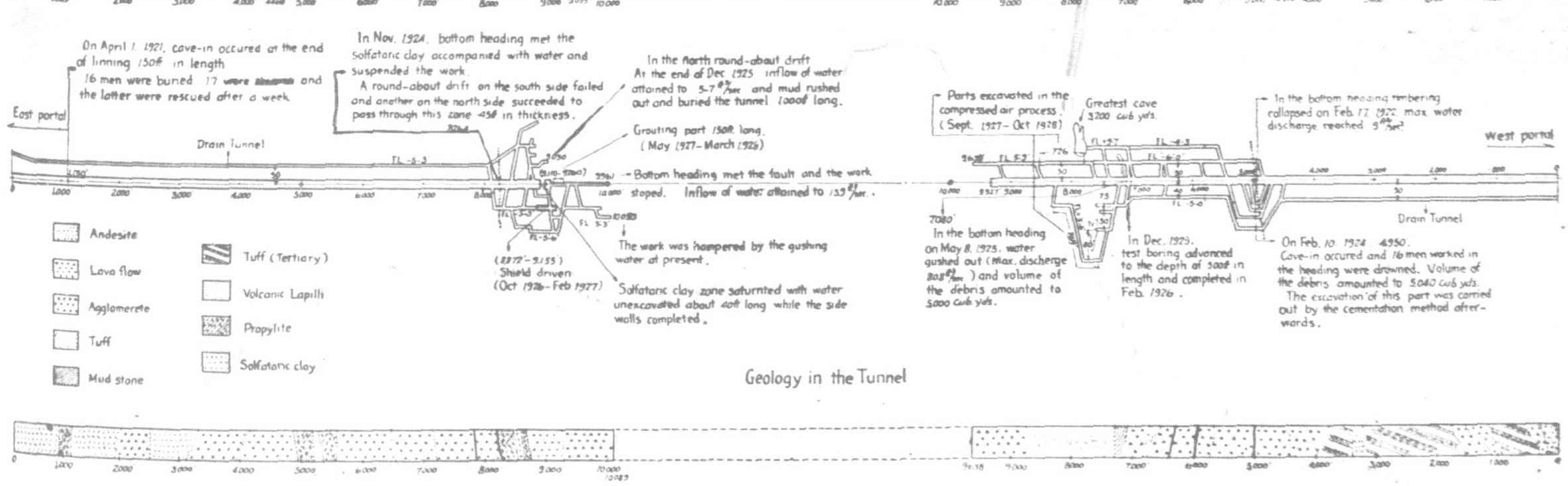
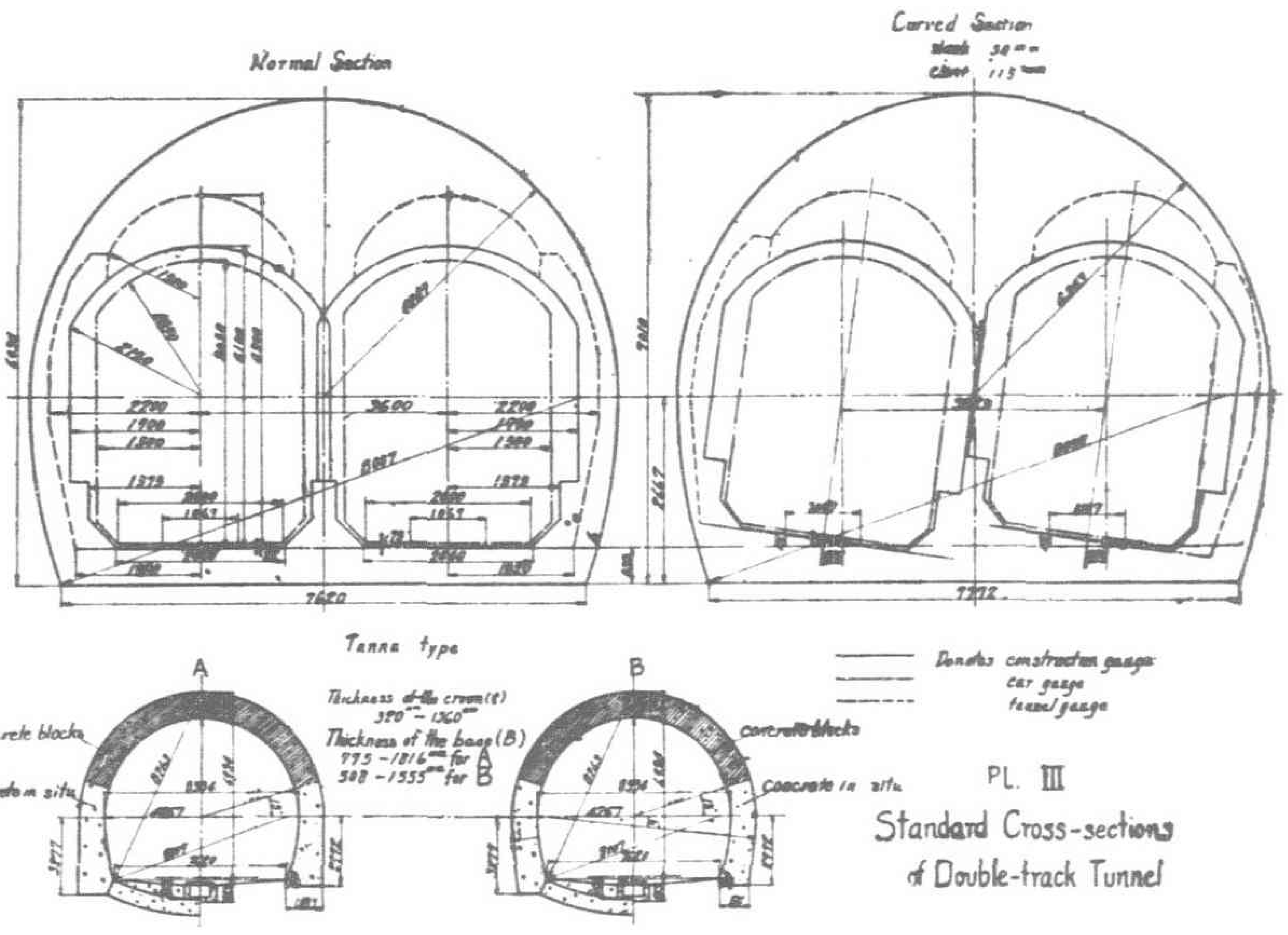


Plate V.—Explanatory Diagram of the Tanna Tunnel



PL. III
Standard Cross-sections of Double-track Tunnel

line and headings are dug both ways. Then this top heading is widened and the bench lowered in two full-width lifts to the bottom-heading roof. Next this main heading is widened on both sides and at last widened again to full tunnel section. Concrete for the lining is poured when enlargement is effected. These stages are shown in Plate IV.

Alternate Bottom-Heading Method.—When rock strata is hard, enlargement of the heading, as described above, is the initial step. Then a 7-ft. driftway is cut into the roof and lifted by successive stages till it reaches the level for a top heading, which is then widened and deepened until roof excavation is effected. All debris is dropped onto the bottom-heading roof and loaded into muck trucks through trapways. Timbering in the bottom heading is removed now and the heading enlarged to full section.

Side-Heading Method.—A third method employed only where exceptional rock formations demand it, begins with two side driftways under the haunches of the tunnel shaft. These drifts are widened toward the mid-part of the tunnel, while a separate top heading is begun. When the side headings have been widened to wall-width and deepened further for the invert, concrete for the walls is poured. Meantime the top heading is enlarged until excavation of the arch section is accomplished, but leaving a center core of material between the side headings. This support serves to hold up the arch centering and molds. Lastly this core is removed and concrete poured into the mid-part of the invert.

In the usual bottom-heading method, two compressed-air drills are used in the bottom heading and one in the top. Operated by air pressure of 80-in. lbs., these drills are mounted on supports wedged against the floor and roof. To blast uncommonly hard rock, dynamite has been used.

The First Great Disaster

First Great Cave-in on Atami Side.—When timbering for a distance of 150-ft. gave way without warning and collapsed over 16 men, instantly killing them and blocking in 17 more at about 980-ft. from the east portal on April 1, 1921, at 4 p.m., a great cave-in resulted. Of the four rescue drifts begun immediately to penetrate the debris, the one run to the top heading was driven through first, enabling survivors to be rescued just one week after the accident.

The nature of the ground where this cave-in occurred is propylitic or trachytic. A fault runs in a west to north direction, meeting the center tunnel-line at a small angle. Its thickness was only a few inches and hardly recognizable, giving no ground pressure to the timbering and no perceptible sign of danger to workmen. Yet it was believed that in the upper part of the tunnel this fault was not so thin and stable, that by a shock from some unknown cause, sliding of the mass collapsed the timbering. A hole 12-ft. long, 6-ft. wide and 3-ft. deep sank on the ground surface about 120-ft. above subgrade.

After rescue work was done, a bottom heading driven through the debris was followed by its enlargement and lining. The collapsed portion for a distance of 180-ft. was re-excavated from both ends by the German method (see Plate IV), and completed in May, 1922, about 12 months after the accident. When the cave-in occurred, the bottom heading had reached 4,450-ft. from the east portal. On account of the accident and subsequent repair work, further excavation was suspended temporarily at 4,468-ft.

With the east heading at 10,200-ft., no advance was made, during about 11 months, from March 8, 1931 until February 2, 1932. Cementation or high pressure cement grouting was carried on radially from the face of the heading into adjacent areas. The loose rock formation was passed by through the cement hardened zone. This spring, at an average rate of about 5-ft. a day, steady headway is being made on the east side.

Flooded Tunnel-Head on Otake Side.—In February, 1922, the west bottom heading at 4,940-ft. entered a fault zone about 60-ft. deep bearing a great volume of water under high pressure. The heading was driven forward, but on February 10, 1924, at 9 a.m. a flood of water gushed out, sealing the passage to the very face of the heading. Sixteen men at work were drowned. Various methods were employed to excavate and line this particular zone. In October, 1926, after four years and eight months of arduous labor, it was completed.

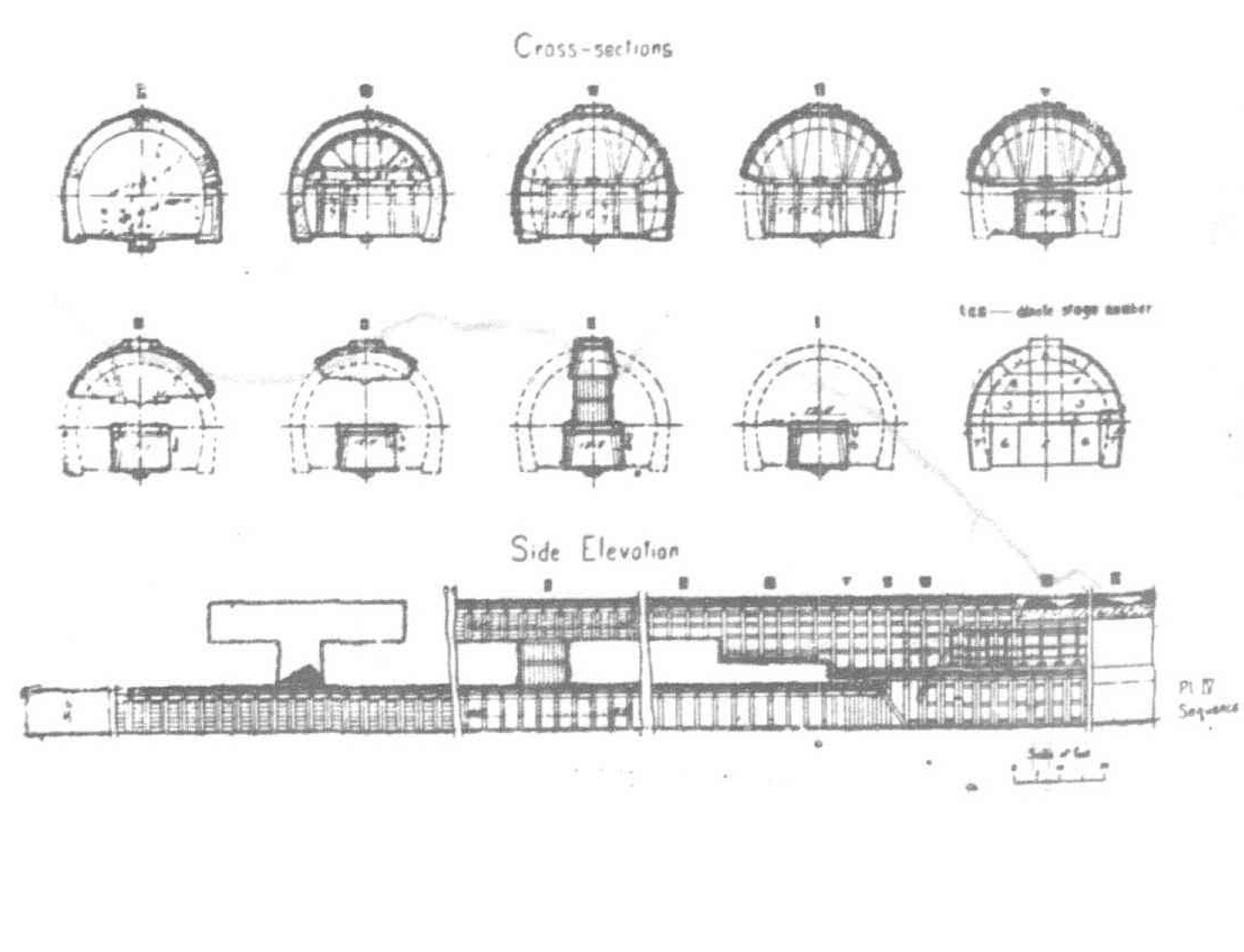
Running Driftways.—After the above accident, an additional drift was begun and the bottom heading was started forward. But the waterflow gradually increased as work advanced. One drain ditch was inadequate so another 4,700-ft. long was dug parallel to the existing one. At 6,900-ft. from the west portal the waterflow was 24 sec. ft. in September, 1924. It rose to 40 sec. ft. by March, 1925. The flow showing no signs of abatement and now becoming too excessive for the capacity of the floor drains, it was decided to drive a drainage tunnel 6-ft. by 6-ft., parallel to the main tunnel but 40-ft. from it and 5-ft. below formation level. Its capacity is 150 sec. ft. A similar drainage tunnel was driven on the east side. These are permanent and as long as the main tunnel.

On May 8, 1925, water together with a great deal of sand and gravel gushed into the west bottom heading at 7,083-ft. The discharge reached 123 sec. ft., causing an accumulation of 5,000 cu. yds. of debris. All efforts were concentrated upon completion of the driftway to drain off this mighty flow. Other work was stopped for about 60 days, and it was 12 months later before this heading was advanced. A stretch of 200-ft. took 2½ years to complete.

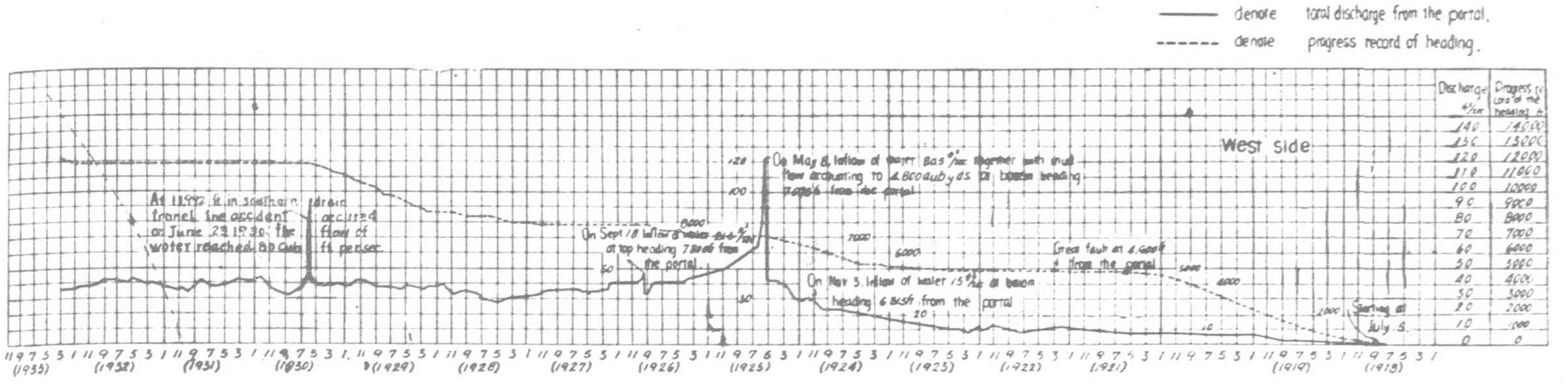
Until the above waterflow began, the heading had been driven through agglomerate not as permeable to water as the lapilli and scoriae (coarse, cellular volcanic sand) now encountered. Water had been imprisoned by the agglomerate and the formation resembled a reservoir under high pressure. Driving through this volcanic lapilli was a serious problem to solve. Through ground of this description, about three years was spent in excavating a distance of not less than 1,400-ft.

Extra-High Pressure on East Side.—At 8,200-ft. from the east portal in November, 1924, soft solfataric clay areas disintegrated by hot spring action were struck. Then a friction-breccia zone, where water flowed at 1 sec. ft. at high pressure, appeared. Seeming on the verge of another serious accident work was temporarily stopped.

This area was wide and intruded by several faults. To make the situation more difficult, the ground held immeasurable quantities of water under high pressure. From December, 1925, to January, 1926, numerous mishaps occurred along this section as



Pl IV Typical Sequence of Excavation



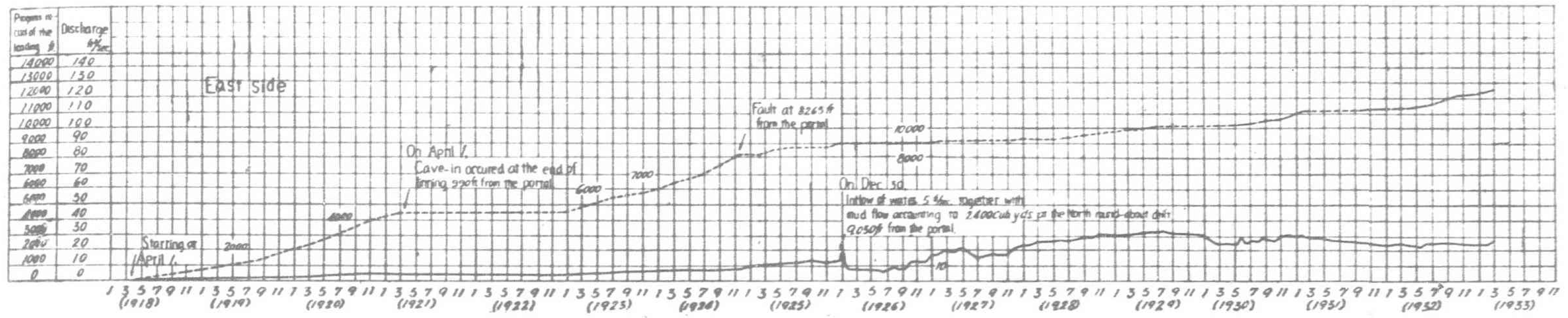
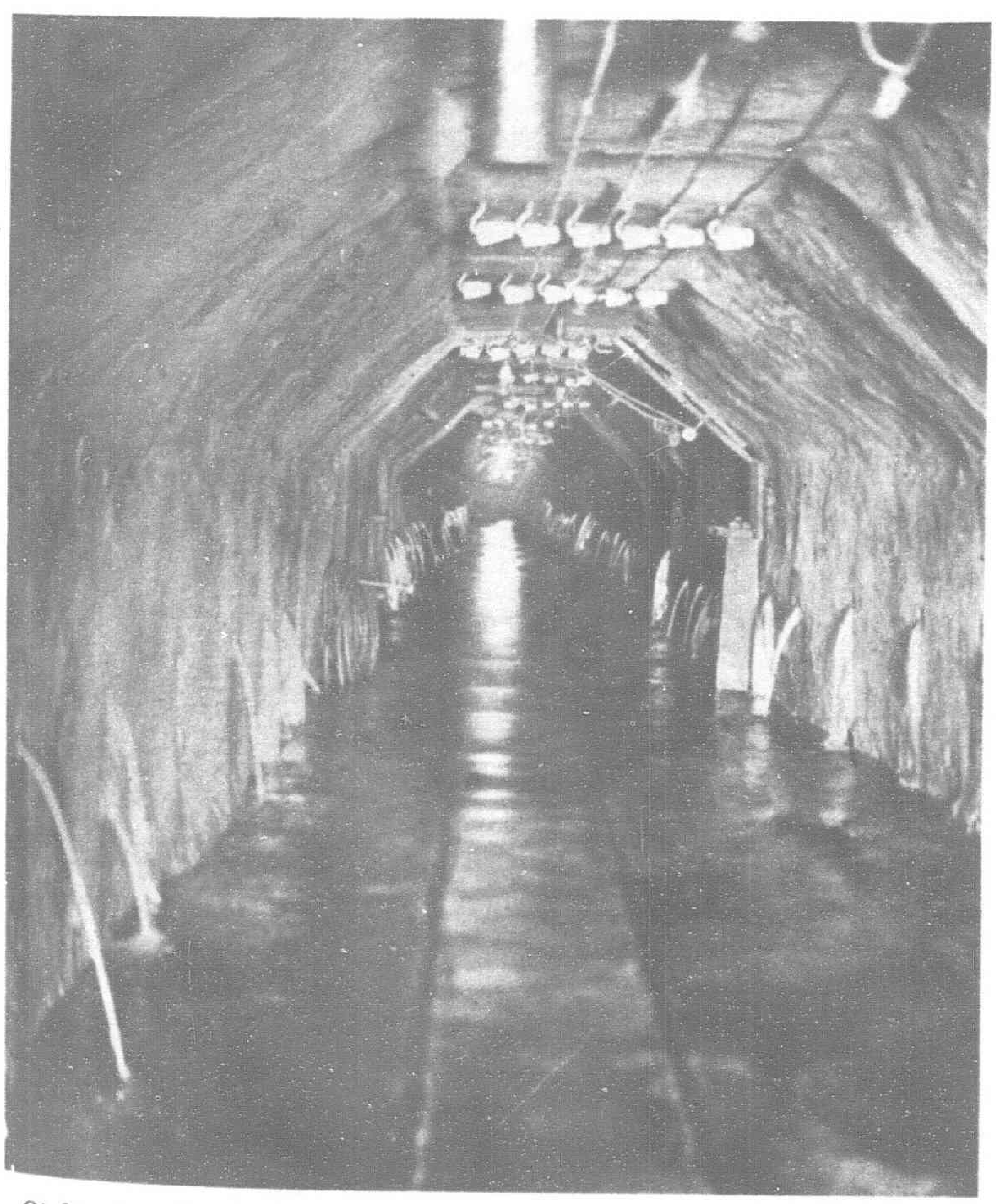


Plate VI.—Total Discharge and Progress Record of the Heading at the Tanna Tunnel in July, 1932

water and clay spouted out in semi-liquid streams. About three and one-half years from the beginning of 1925 was required to drive through approximately 1,000-ft. on the east side. The bottom heading passed out of this zone in May, 1928.

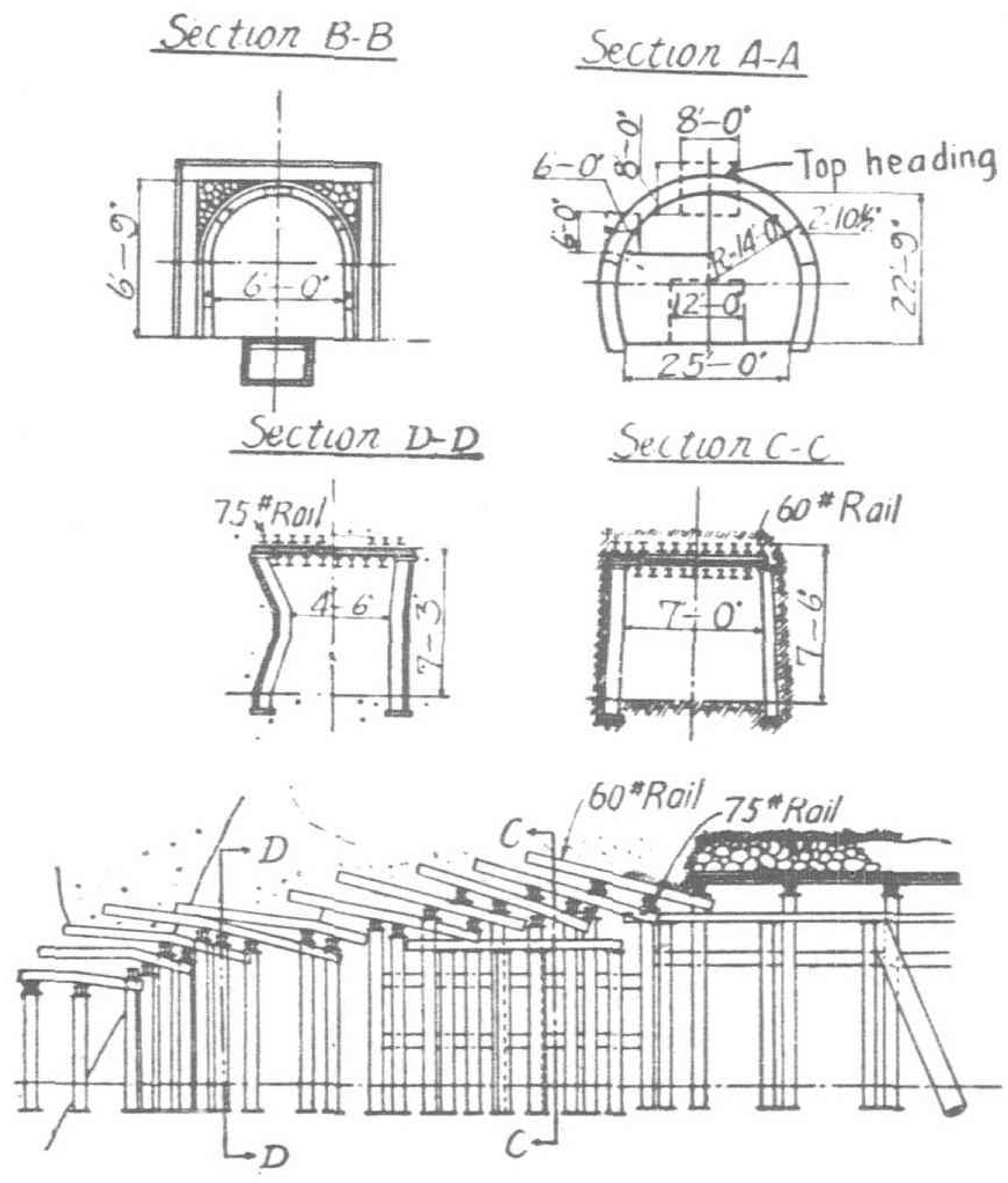
Special Work in West-Side Fault Zones.—With the west bottom heading at 4,900-ft. early in February, 1922, the character of interfluent agglomerate changed, but the water and ground pressure remained constant. Excavation proceeded with additional timbering. On February 16 the heading broke into a water-bearing pocket of fault-breccia at 4,940-ft. Soon after this a sudden rise in waterflow was noted along some 30-ft. of the tunnel shaft. Timbering was under such high pressure that it had to be reinforced. Serious trouble came the next day when timbering collapsed and the tunnel roof caved in with torrents of water, mud, sand and gravel gushing out. Gradually damage spread backward for 50-ft. as debris amounting to 120 cu. yds. flowed out with water at 9 sec. ft.

To prevent loosening of contiguous ground, timbering underwent another reinforcement and its face was bulkheaded with cement. No more change being noticed in waterflow and the

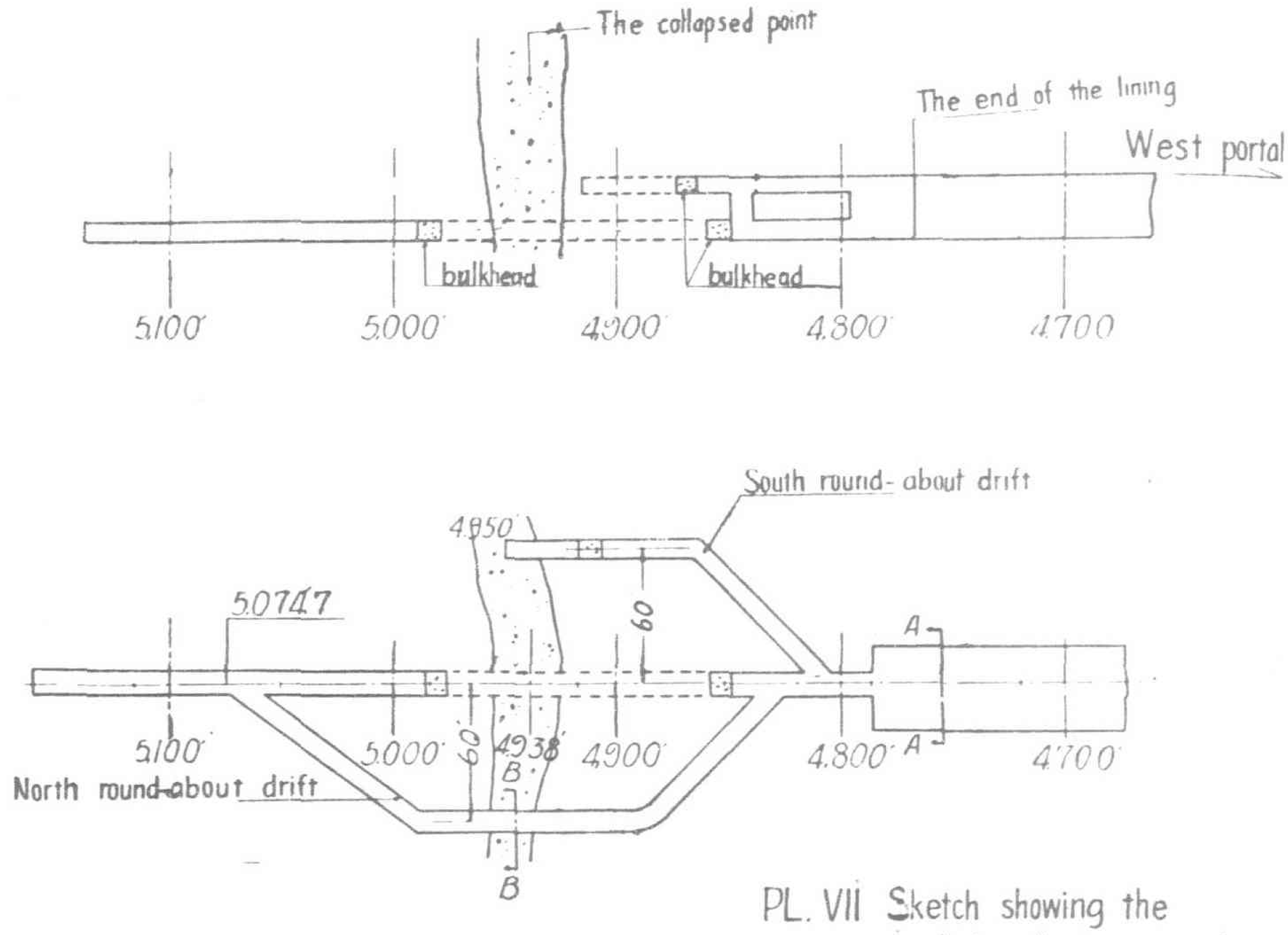


Otake (west); Drain Tunnel Excavated and lined Under Compressed Air, (8,000-ft. from the Portal), February, 1929

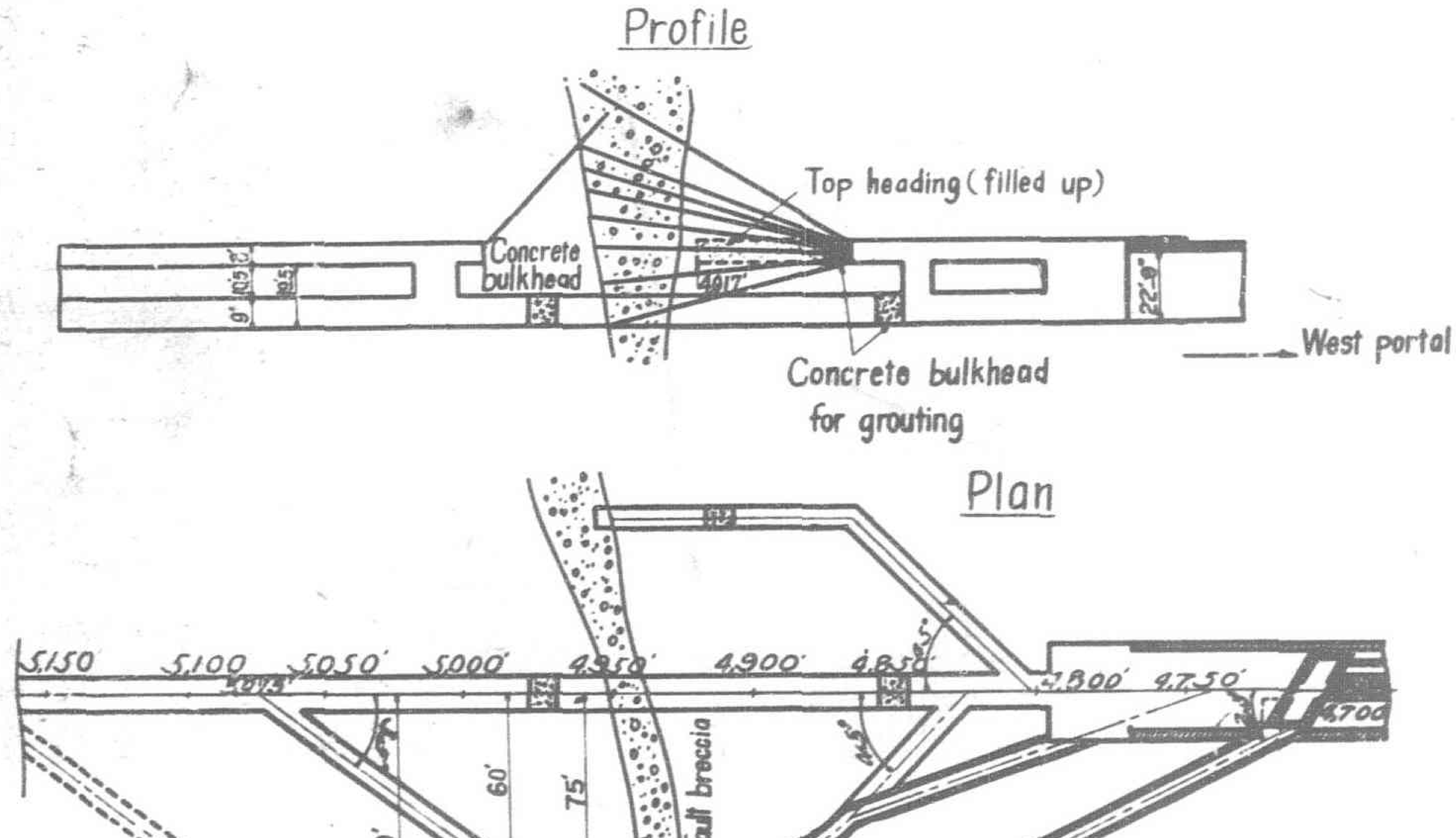
Face of Wet Drift Tunnel at 9,216-ft. from East Portal, February 5, 1928



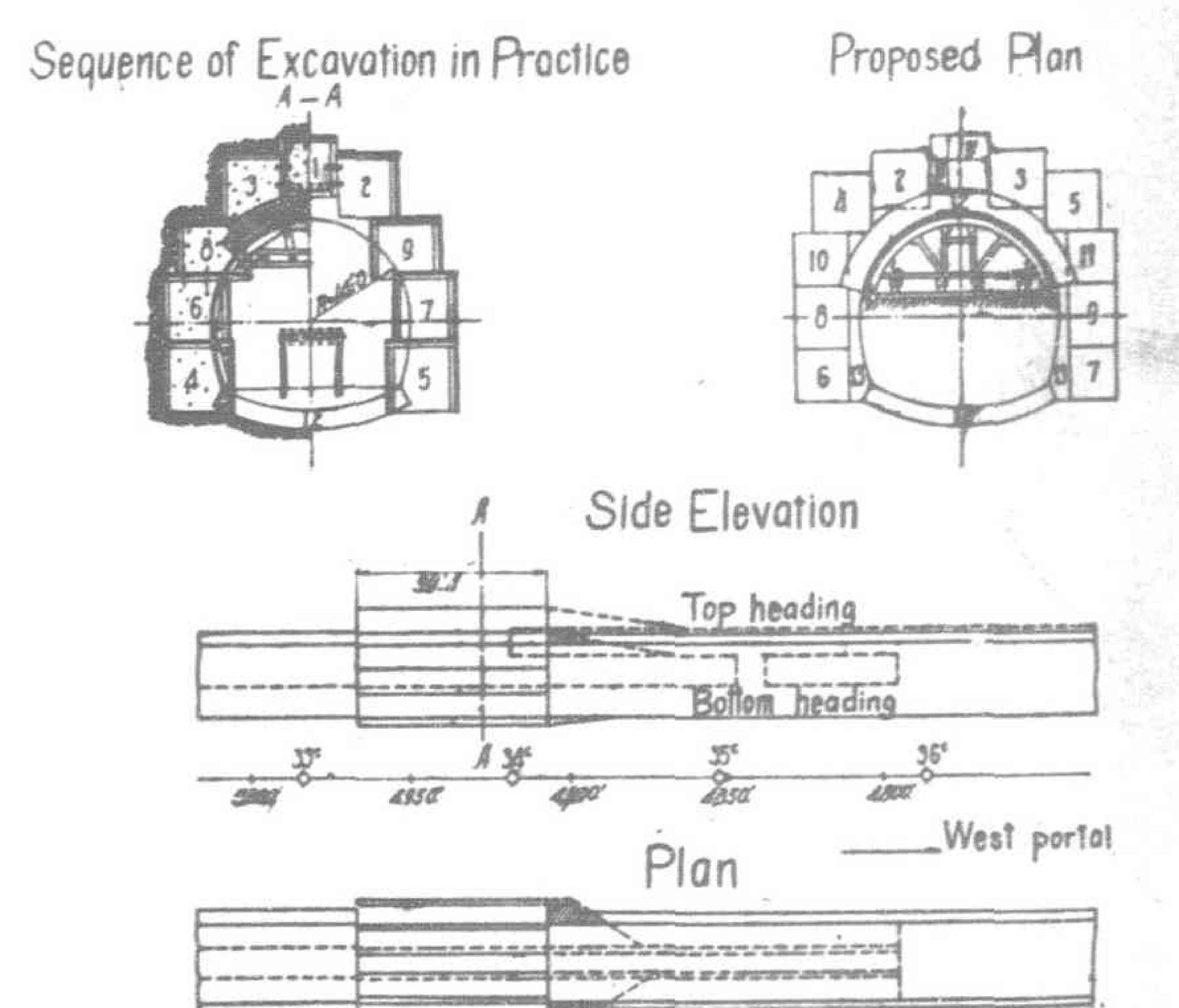
Timbering at the fault zone on the main heading. (West of 4938 ft. from the west portal)



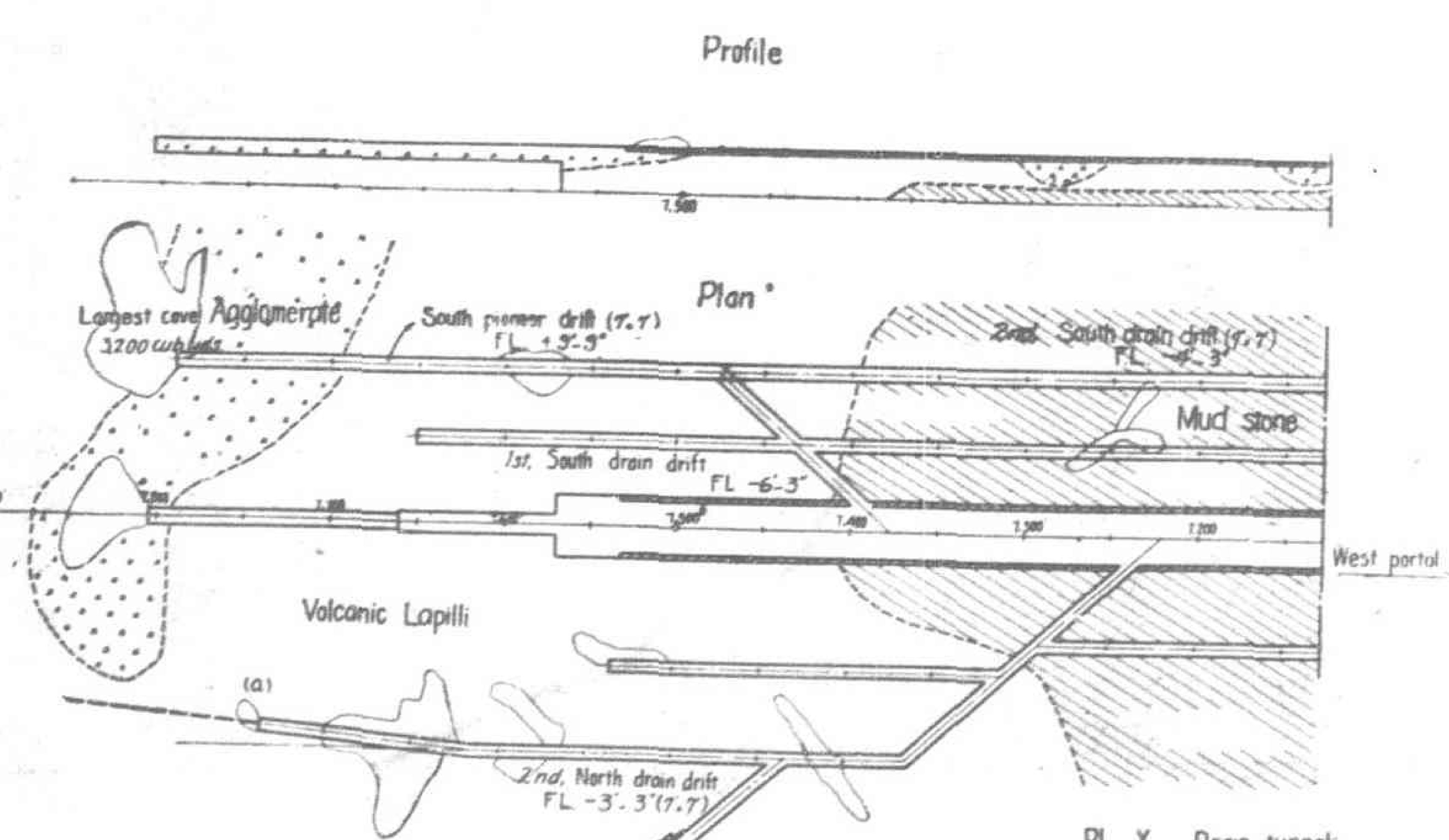
PL. VII Sketch showing the progress at which collaption occured at 4950 ft from the West portal.



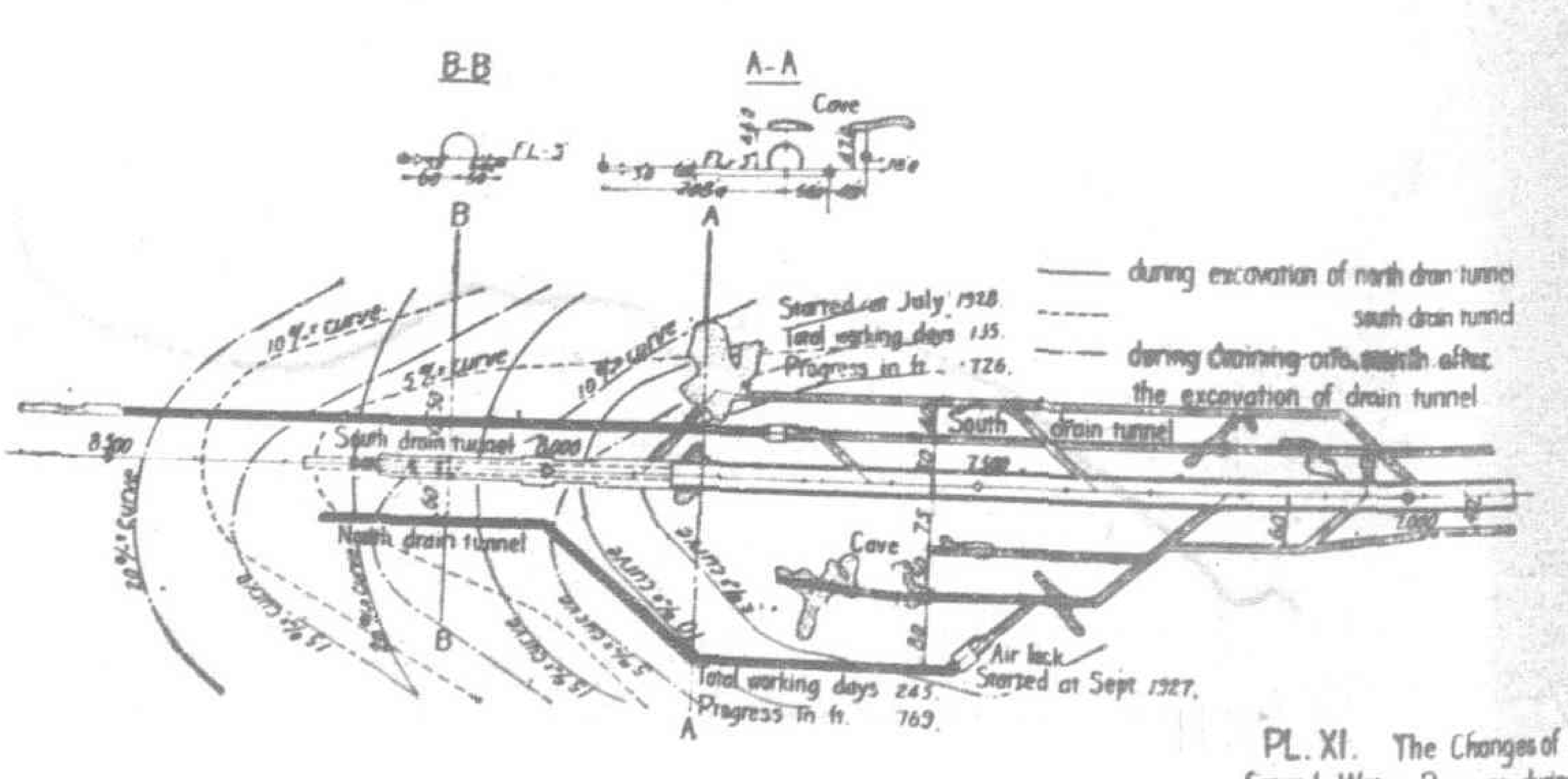
PL. VIII. Cementation process at the fault zone near 4,950 ft from the West portal



PL. IX. Sequence of Excavation in the Fault Zone near 4,950ft from the West Portal



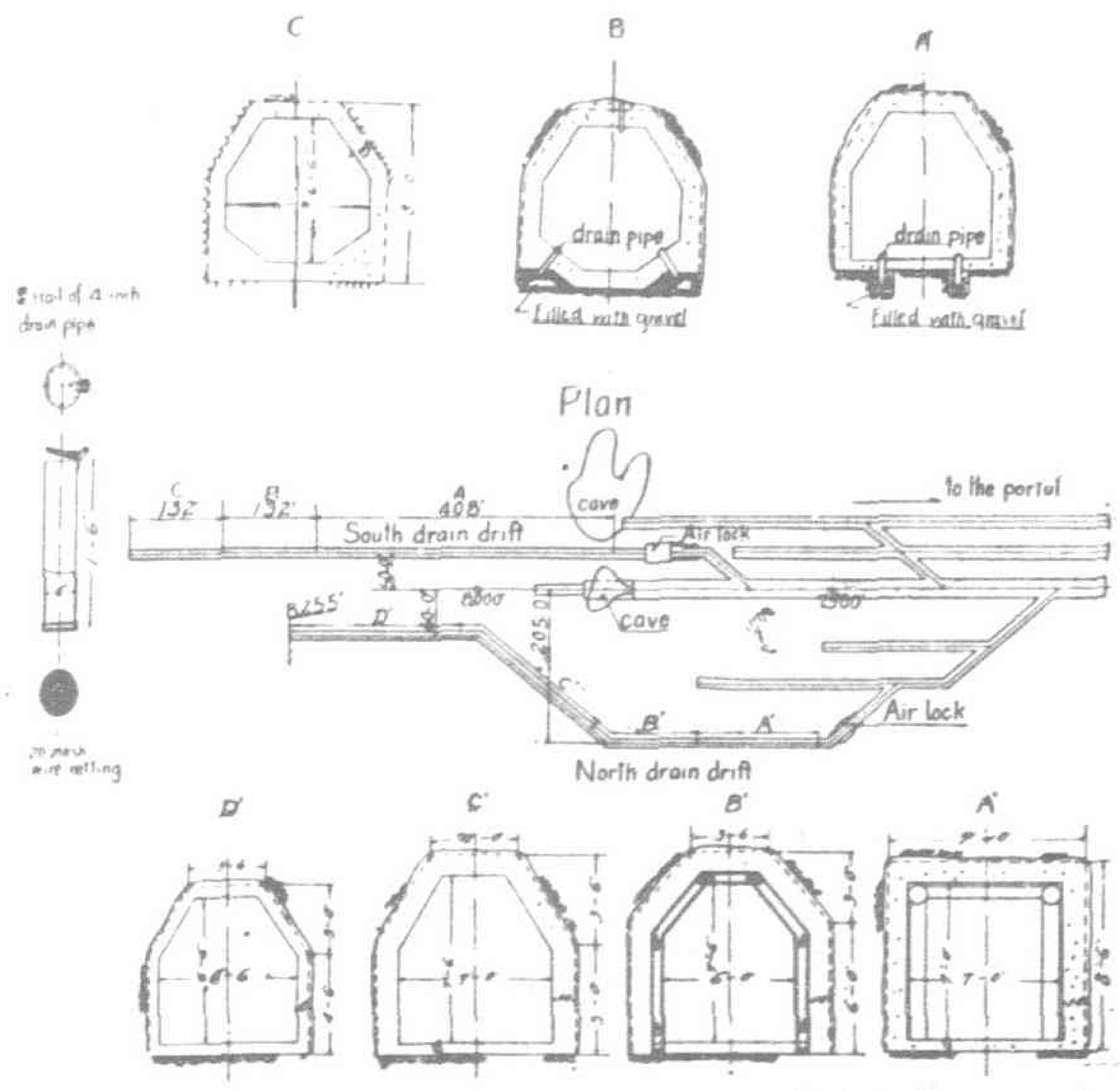
PL. X. Drain tunnels and Caves produced on the West side.



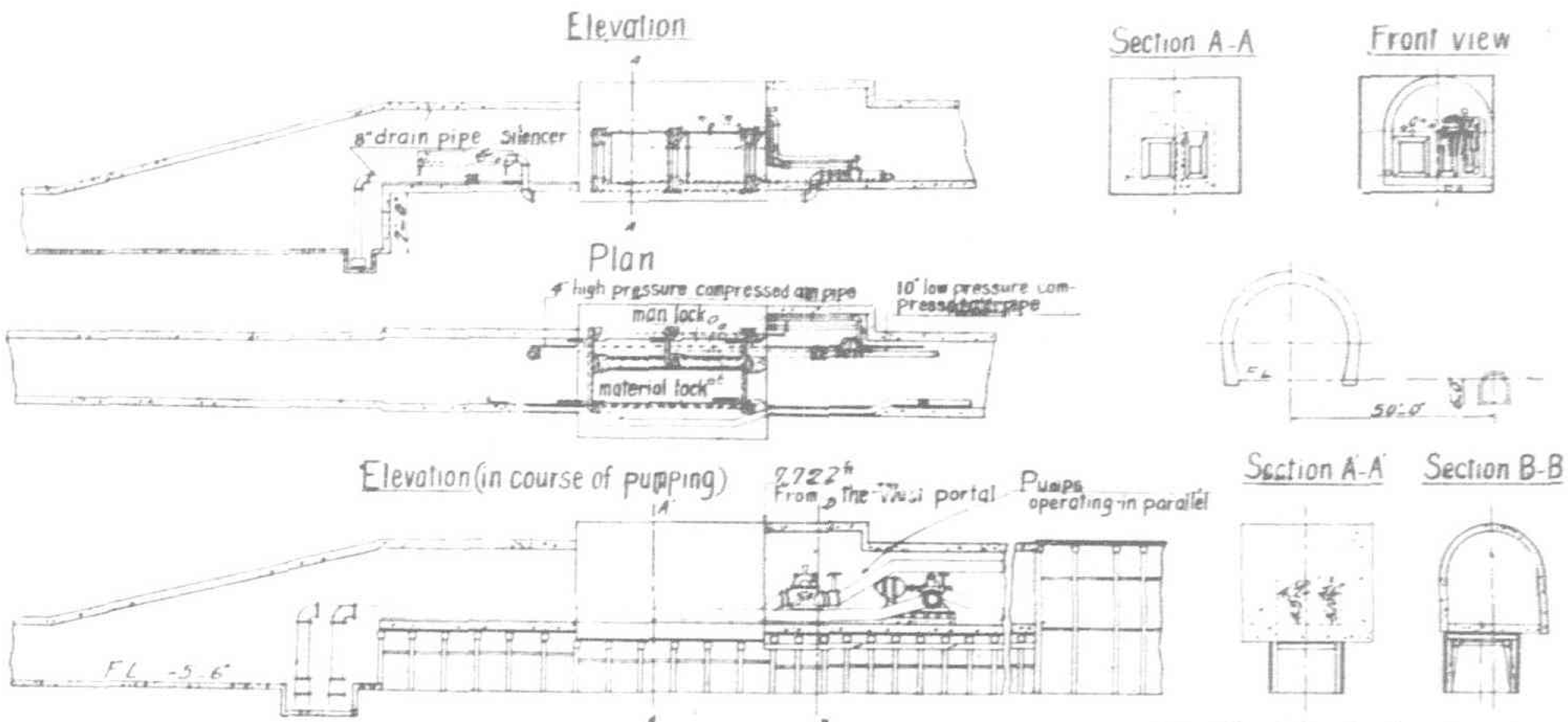
PL. XI. The Changes of the Ground Water Pressure during Excavation in Compressed Air on the West side

debris seeming to be solidified, spile-driving through the debris was undertaken. Headway, slow and possible only by degrees, was hindered by boulders and heavy ground pressure. Further work becoming next to impossible, reinforcements were put in here consisting of posts of 6-in., cold-drawn steel pipe poured with cement carried caps of three 75 lb. rails supporting the poling boards of 60 lb. rails. Notwithstanding, pressure was so great that rail poling and posts buckled, thereby narrowing the size of the heading. Finally, at 4,938-ft. driving was suspended. (See Plate VII.)

A top heading was now driven to investigate the quality of the ground. When it reached 4,917-ft., about 950 cu. yds. of

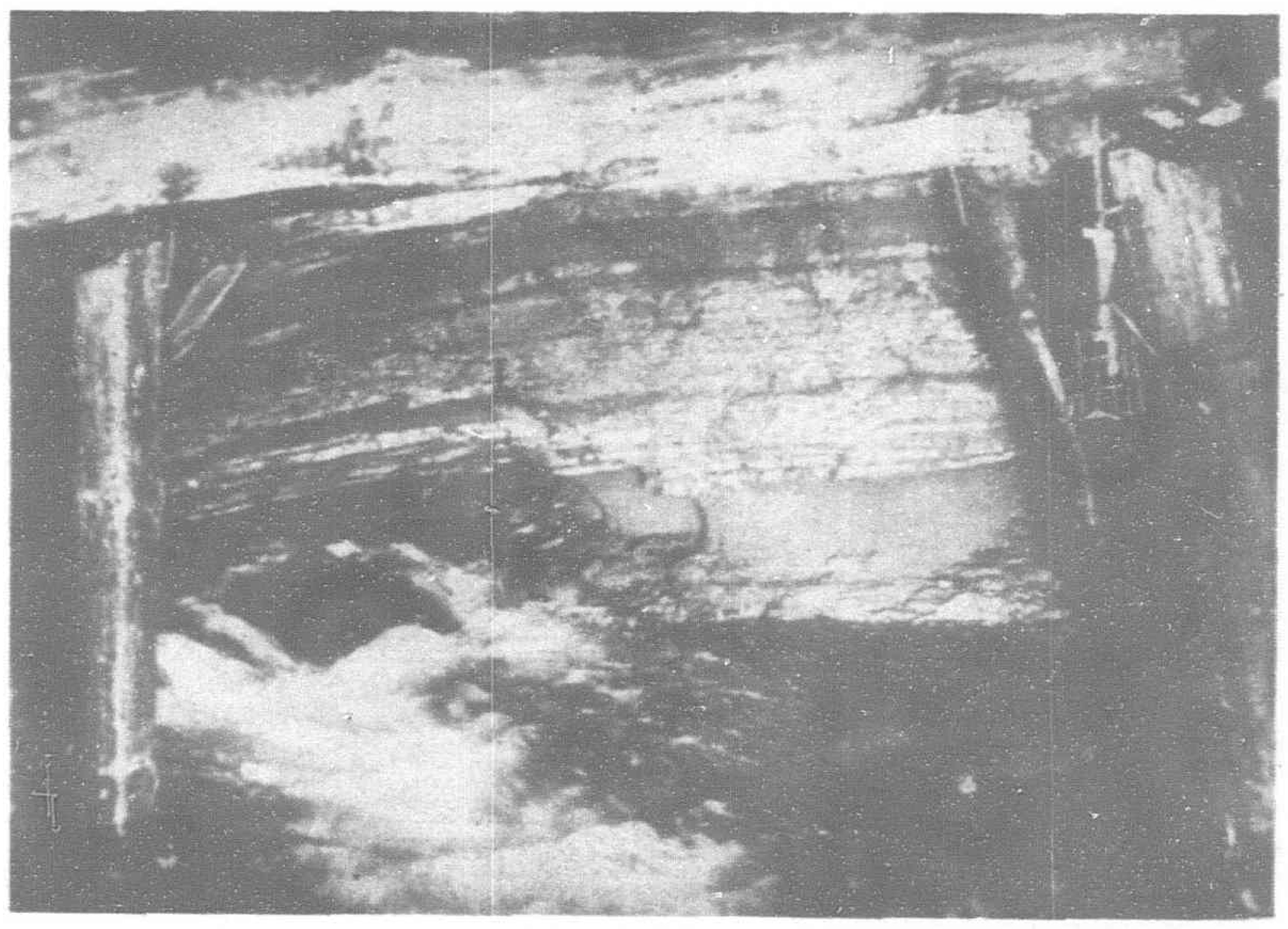


PL XII Compressed Air Process on West side.



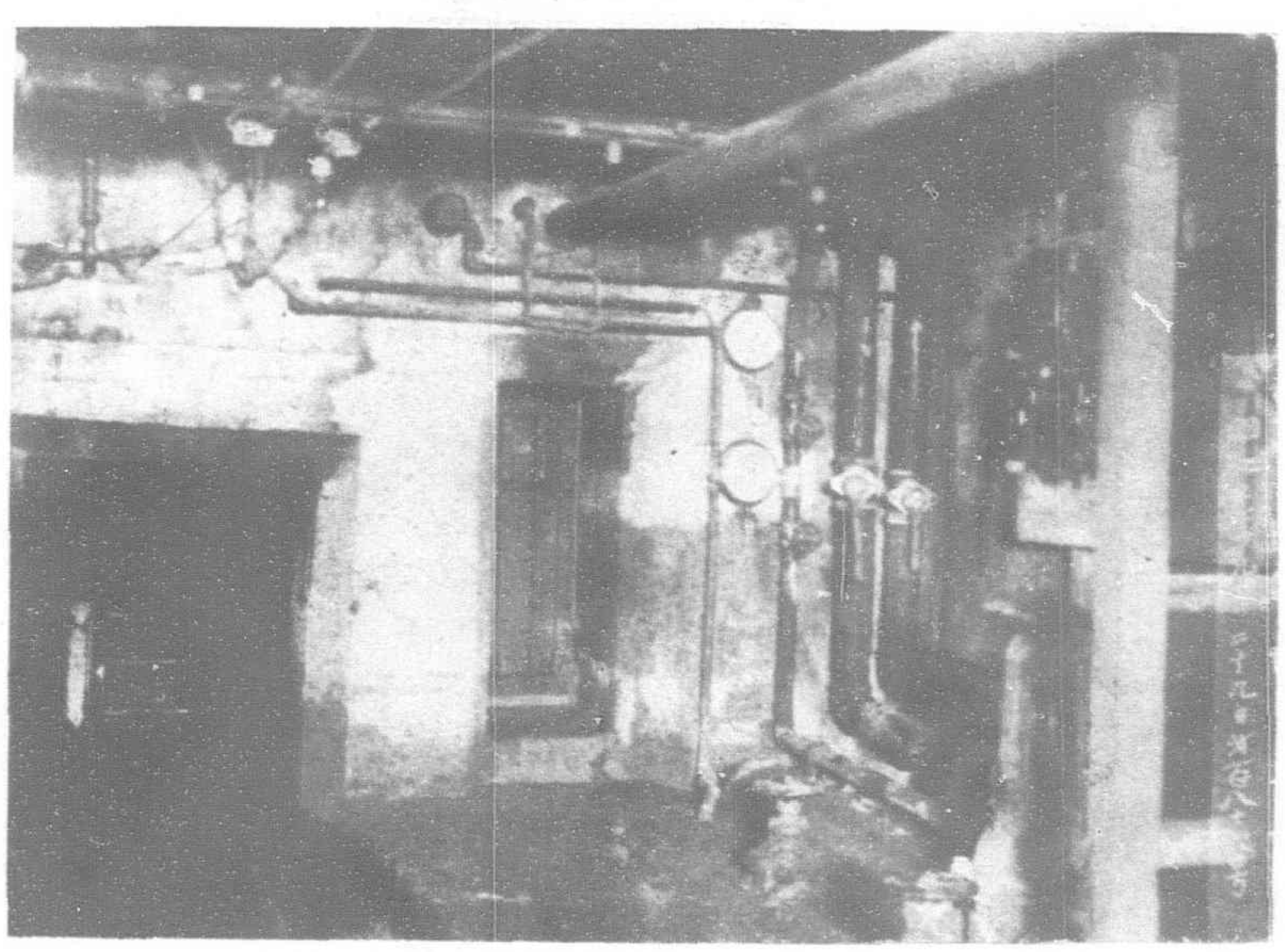
PL XIII The Air Lock used for the Compressed air process on the West side

Water-Flooded West Approach to Tanna Tunnel after accident in Main Heading, 7,080-ft. from Portal, May 8, 1925 at 5 p.m., Maximum waterflow 132 sec. ft.

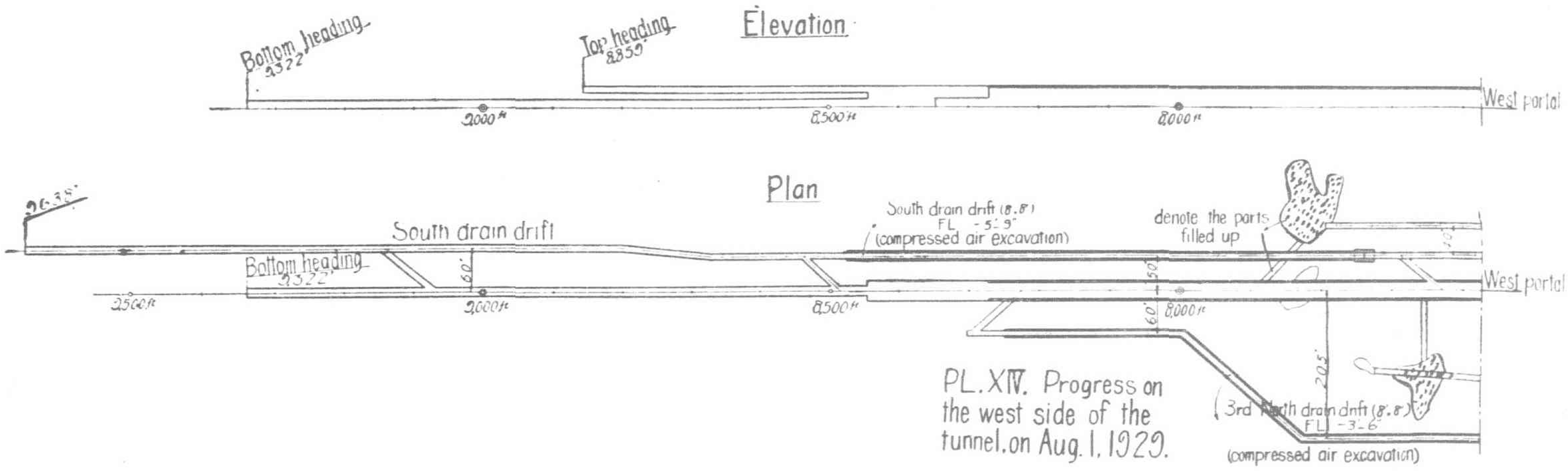


Torrent from Fissure in Tapped Water Pocket at West Main Heading spouted at rate of 28 sec. ft., July 28, 1926

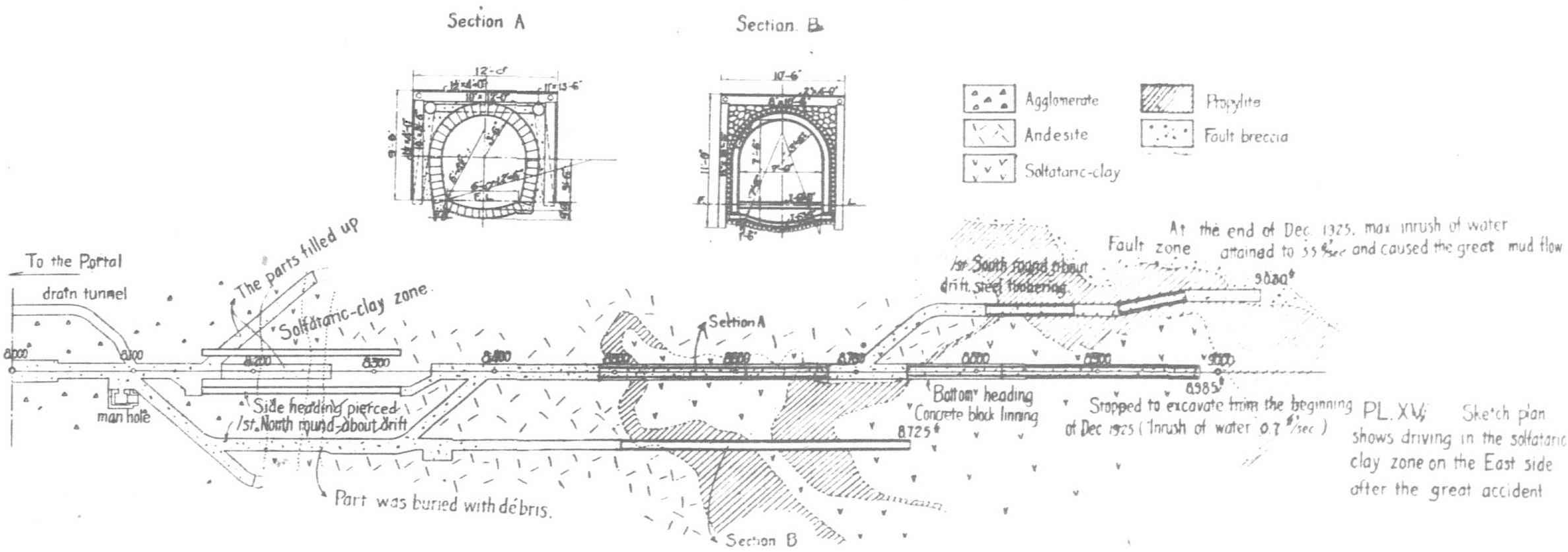
Segmented Steel Lining Shield Driving in Drainage Tunnel at 8,950-ft. from East Portal, January 4, 1927



Close view of Compressed-Air Lock Apparatus in West Side Drainage Tunnel, September 29, 1927



PL. XIV. Progress on the west side of the tunnel, on Aug. 1, 1929.



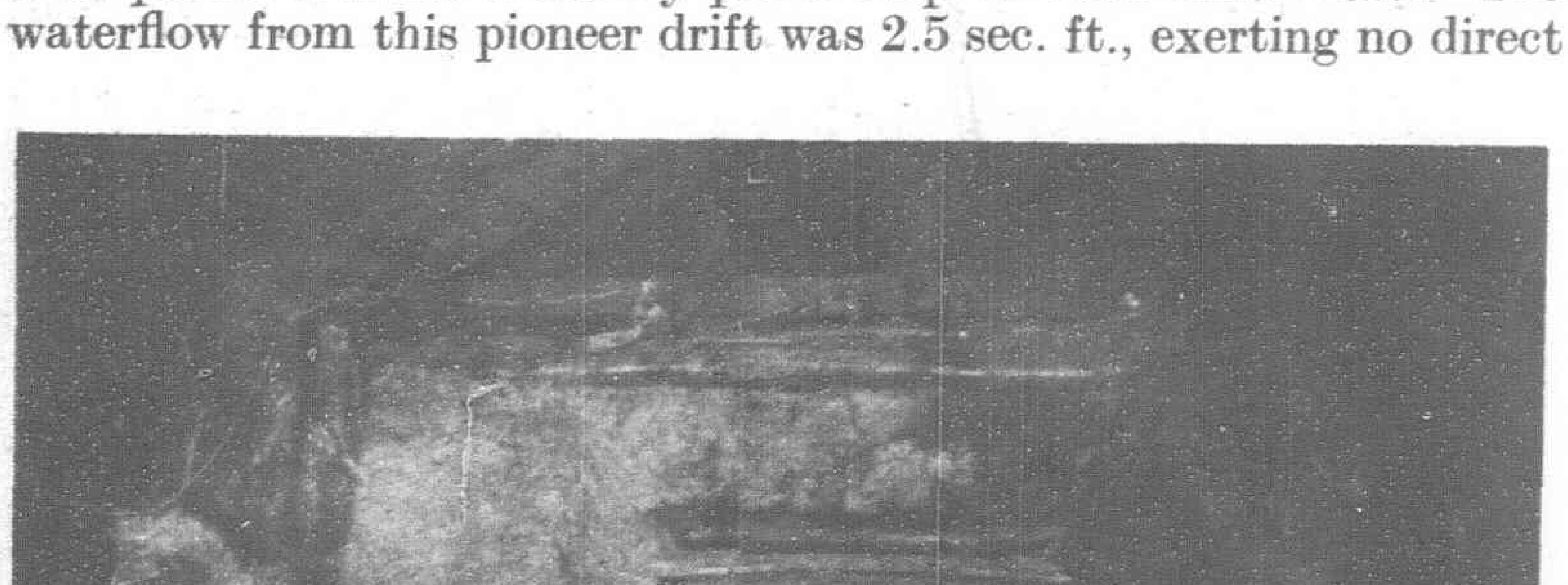
PL. XV. Sketch plan shows driving in the solfataric clay zone on the East side after the great accident

earth with a torrential outpour of water suddenly burst into the heading, again stopping work. Under such conditions driving was impossible by the usual method. Abnormally high water pressure rather than ground loosening was responsible for the difficulty. The water pressure would grow less—as seen from past experience—in direct proportion to the volume of flow, which was destined sooner or later virtually to cease. Time required for its exhaustion would be inversely proportional to the volume of the discharge. Thus it was necessary to drain off the water at a safer point.

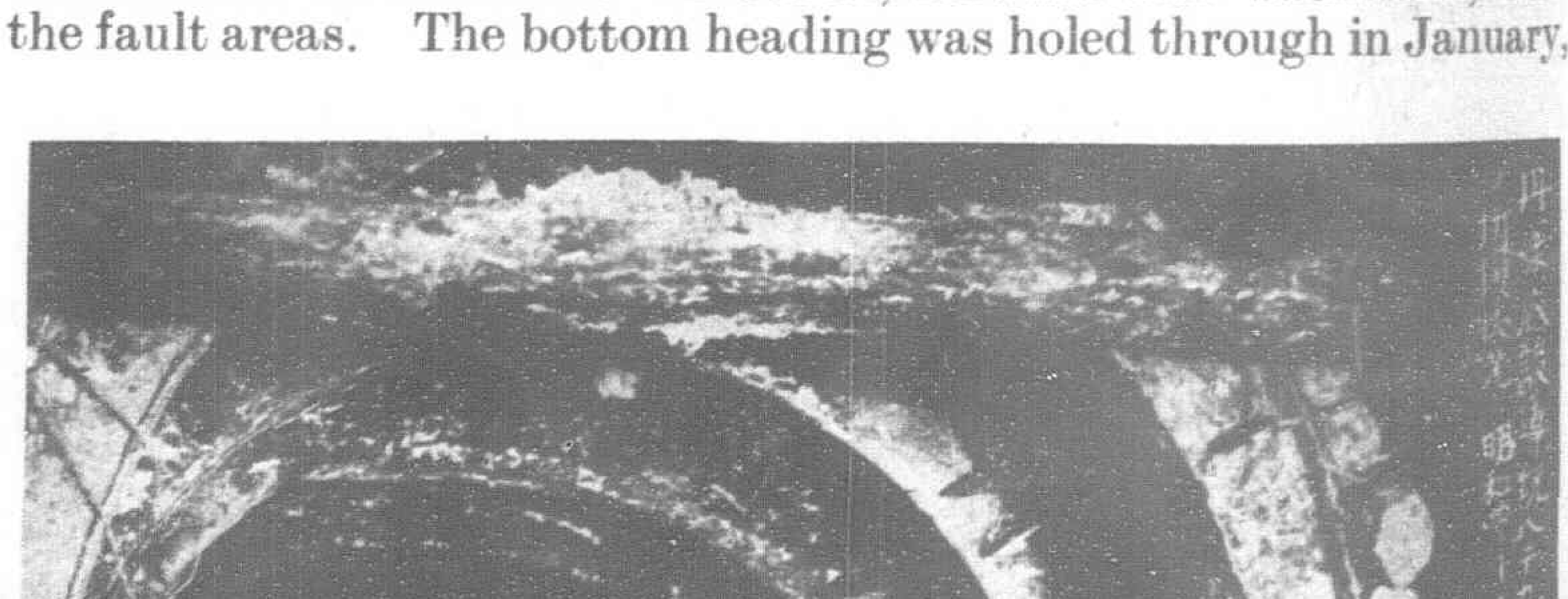
A drift for a by-pass was run on the south or right side 60-ft. from the center line of the main tunnel. At 4,940-ft. from the west portal another difficulty put a stop to work once more. The waterflow from this pioneer drift was 2.5 sec. ft., exerting no direct influence on the bottom heading. Almost a year passed at this work.

A test bore from the face of the bottom heading horizontally along the center line of the main tunnel, following up the bore begun March, 1923, was sunk 300-ft. when it was found that the unfavorable area, though solid, was badly shattered agglomerate and andesite containing much water under pressure as high as 110-in. lbs.

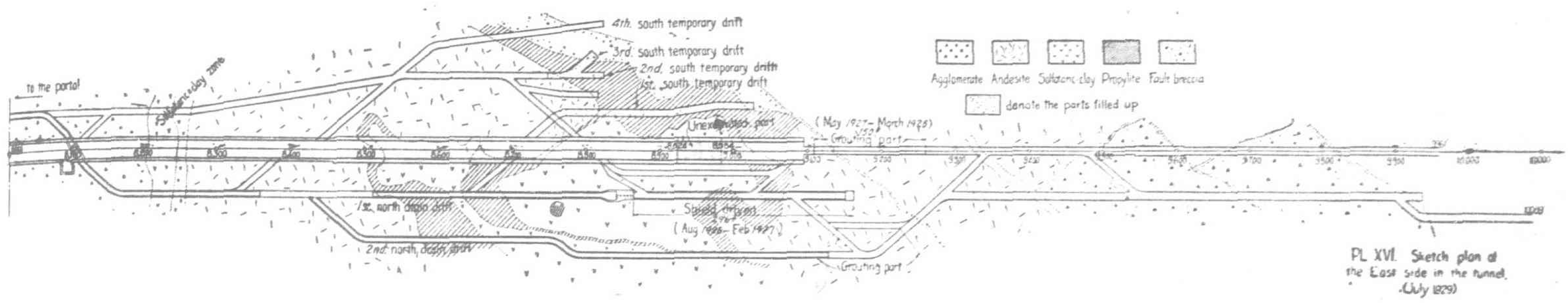
On the north or left side another pioneer drift was begun with utmost precaution. A safe passage was driven into solid ground. When the drift reached the center line of the main tunnel, work was carried on from two directions, forward and backward, into the fault areas. The bottom heading was holed through in January,



Center Main Heading connecting with Side Wall Heading in soft Solfataric Clay at 9,030-ft. from East or Atami Portal, March, 1929



Steel I-Beam Timbering Buckled by Swelling Ground 8,900-ft. from East or Atami Portal, February, 1929



PL. XVI. Sketch plan of the East side in the tunnel. (July 1929)

1924, but some enlargements were necessary because the heading already excavated was too narrow for muck cars. (See Plate VII.)

Probing Causes of Flood

On the morning of February 10, 1924, when enlargement of the west bottom heading was underway and the aforementioned accident occurred drowning 16 workmen, there was no means of determining the real cause of the flood. It was supposed that in widening the heading, the removal of a boulder must have weakened resistance against water pressure, thus releasing pent-up water and loosening the earth, which came with the torrent of water, mud and sand. The violent irruption, due to high water pressure, filled up the inner parts of the bottom heading and pioneer drifts. Workers in the bottom heading were thus trapped and drowned probably within an hour's time. The debris which flooded the tunnel to 1,200-ft. of the portal amounted to 5,040 cu. yds. and the waterflow reached more than 20 sec. ft. A rescue drift was driven till it struck the flooded bottom heading. Seventeen days after the accident all the bodies were recovered.

Before the mishap, if water pressure were low enough, it had been planned to hole through the bottom heading and excavate the breccia zone by the usual method. But now these expectations had to be given up, and instead cement grouting was laboriously sunk. Another driftway for a by-pass was run to open a passage on the north side into the inner part of the bottom heading. In this way the heading was driven forward independently of work at the fault zone. (See Plate VIII.)

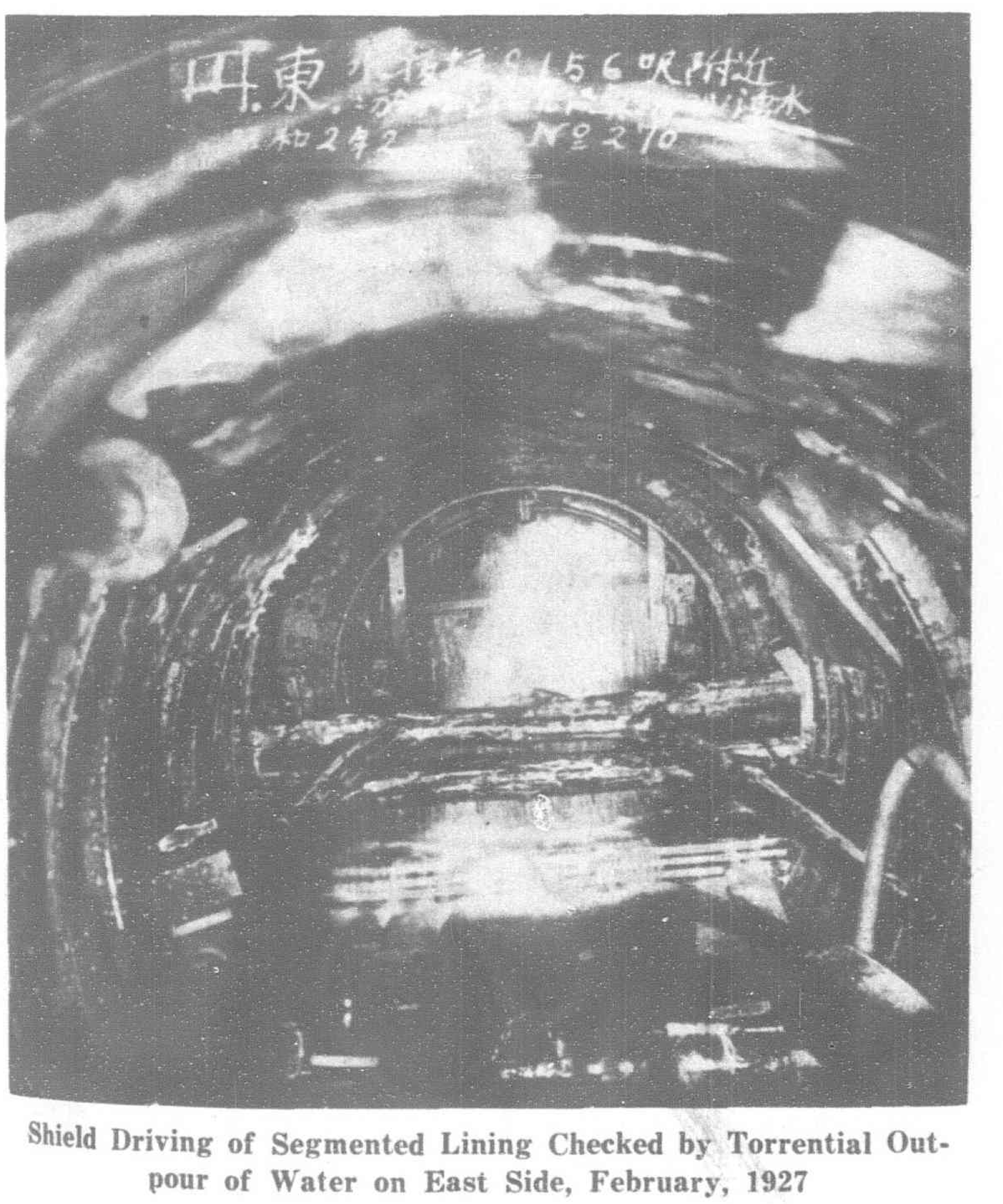
A test bore was made, before cement grouting was completed, to learn how much the ground about the spot had been loosened by the accident and whether there was still a void resulting from the cave-in. Extreme difficulty in boring through the breccia, however, prevented sufficiently reliable knowledge from being gained.

To prevent loose ground from caving under grouting pressure, the face of the bottom heading when treated with cement grouting and the heading approach as well as the drifts were blocked with concrete bulkheads 9-ft. thick. So that water pressure, which might have become higher from the pressure of grouting, could be relieved, three holes, each 56 to 78-ft. deep, were drilled radially from the top heading to grout cement into the region lying 25-ft. outside the tunnel lining. This work was finished by the last of December, 1924. About 1,800 cu. ft. of cement was grouted by air pressure up to 300-in. lbs.

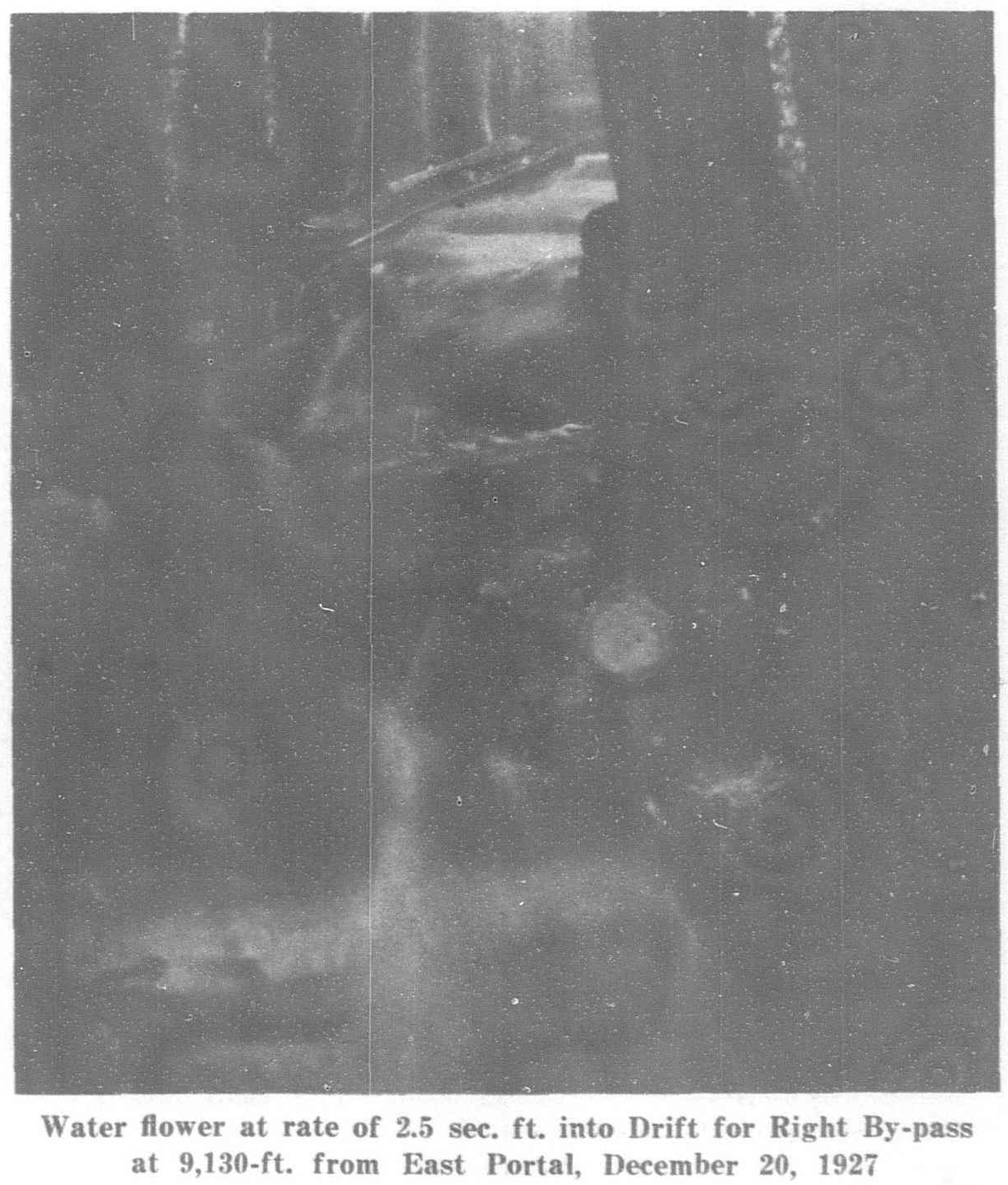
The result of this grouting, as determined in January, 1925, showed that it had little effect upon the breccia. A tendency toward water and mud flow still existing, 15 more holes were drilled, with perforated pipes inserted into them, along the full length of the breccia zone. This was done that cement might be injected well into the area.

Solutions of calcium chloride ($Ca\ Cl_2$) and sodium silicate ($Na_2\ Si0_2$) were alternately injected and the bore holes grouted with cement. After the second grouting at the end of October, 1925, the quantity of both chemicals and cement used was 119,900 lbs. and 1,860 cu. ft. respectively.

When these holes were drilled, scarcely any water was found in the grouted zone, but water pressure was still high in the ground more than 100-ft. above subgrade. The purpose for grouting having been realized, enlargement and lining of the main tunnel continued. As a result of the caving-in of about 8,000 cu yds. of earth, it was suspected that there were one or two caves and some quantity of water in the vicinity. For this reason a special excavating method followed. (See Plate IX).



Shield Driving of Segmented Lining Checked by Torrential Outpour of Water on East Side, February, 1927



Water flower at rate of 2.5 sec. ft. into Drift for Right By-pass at 9,130-ft. from East Portal, December 20, 1927

Big Spout of Water under pressure of 300-in. lbs. gushing into Drift for Right By-pass, 9,081-ft. from East Portal, September 7, 1927

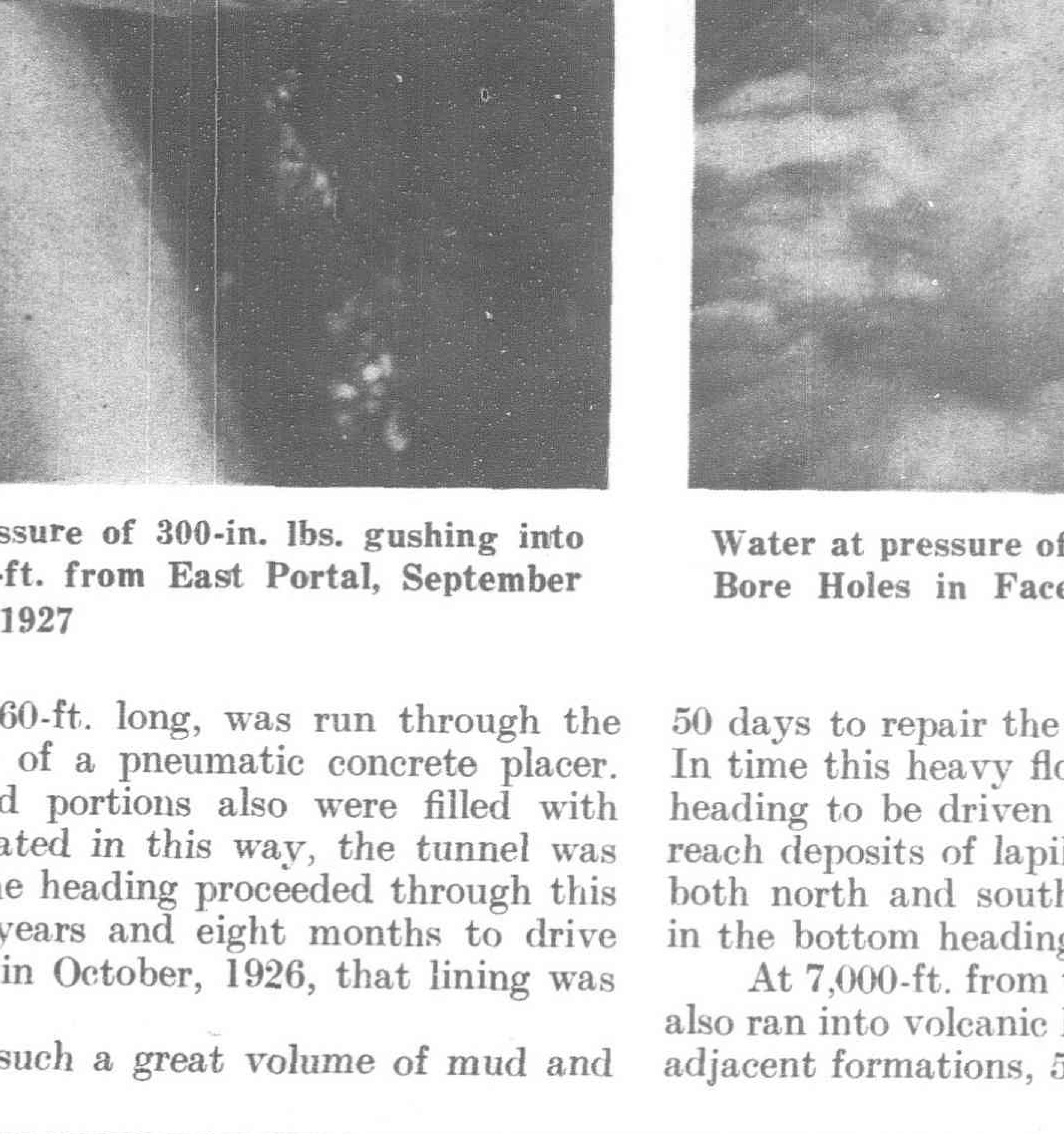
Water at pressure of 300-in. lbs. Gushing into Pioneer Drift from Bore Holes in Face at 9,180-ft. from East Portal, November 10, 1927

First a small drift, about 60-ft. long, was run through the fault zone and filled by means of a pneumatic concrete placer. After setting, further excavated portions also were filled with concrete. The work being repeated in this way, the tunnel was surrounded with concrete and the heading proceeded through this buttressed area. It took four years and eight months to drive through this section, and it was in October, 1926, that lining was effected.

It seemed remarkable that such a great volume of mud and sand and water, causing the death of 16 workmen, could have flowed out through an opening only 9-ft. by 6-ft. The suspected caves were never found.

Concluding from results of the initial grouting, it was not believed that the second attempt effectually checked waterflow. On the contrary, it was taken for granted, due to the continuous, heavy flow of the previous three years, that a subterranean reservoir, at times under high pressure exceeding 110-in. lbs., was ultimately exhausted and that the natural fall of water pressure had much to do with making the grouting effective.

Driving through Volcanic Lapilli on Otake Side.—When the west bottom heading at 7,083-ft. on May 8, 1925, struck an area of volcanic lapilli invaded by water which flowed out at a maximum rate of 123 sec. ft., as briefly mentioned above, it took some 50 days to repair the damage and clear away the resulting debris. In time this heavy flow subsided to 60 sec. ft., permitting the top heading to be driven forward with its enlargement following. To reach deposits of lapilli ahead, a drainage tunnel then was run on both north and south sides as rapidly as possible so that water in the bottom heading could be drained off without delay.



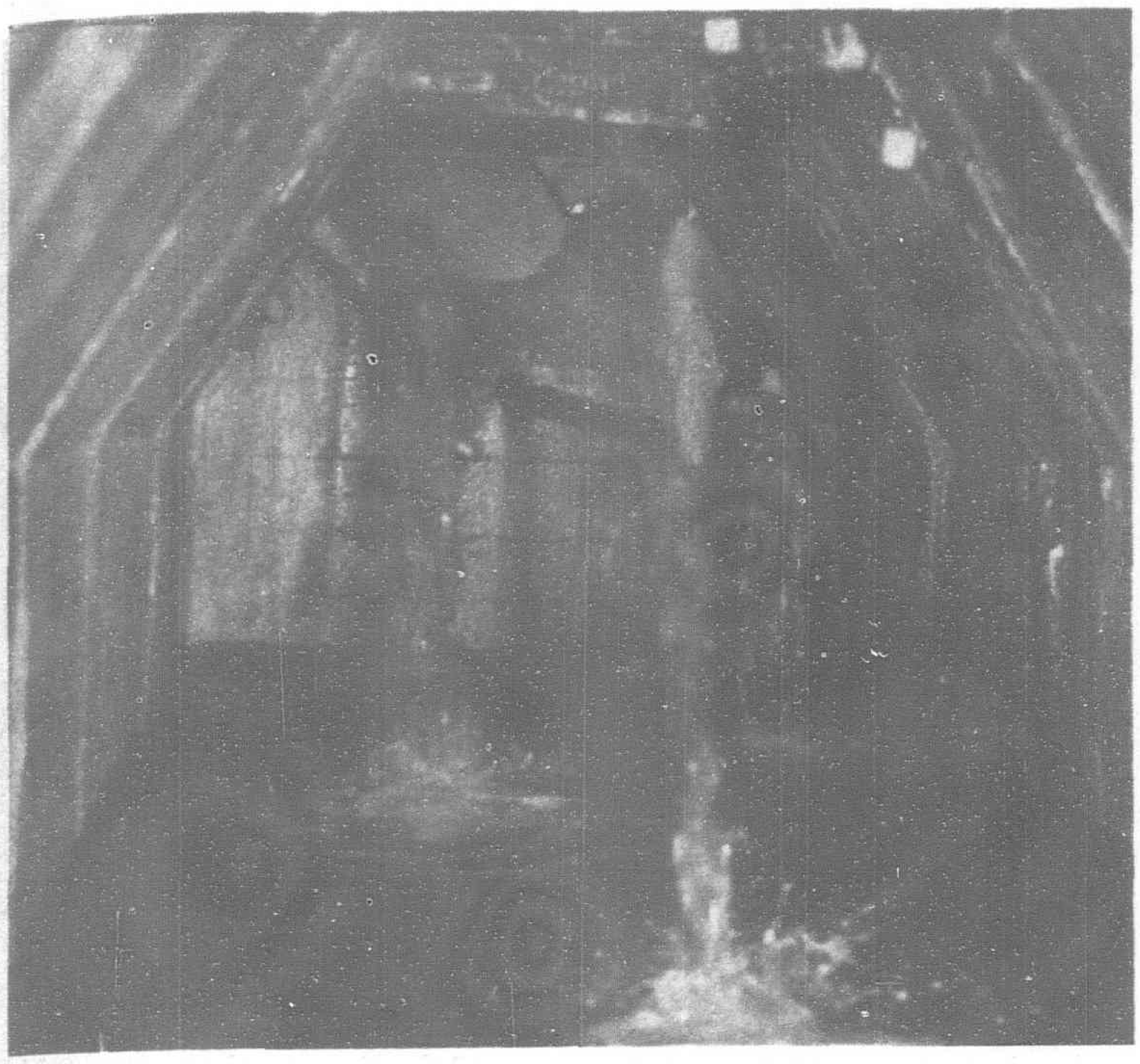
PL.XVII.
Shield and Segments at Faulted Rock.

At 7,000-ft. from the portal in December, 1925, the top heading also ran into volcanic lapilli and work was stopped. To investigate adjacent formations, 500-ft. test holes were bored horizontally into the earth. The area was composed of lapilli with intercalary andesite and agglomerate. In three places these bores tapped cavities caused by the aforementioned cave-in. Water pressure having fallen appreciably by this time, the first flow through the holes came at 290-ft. from the tunnel face. At nearly 500-ft. the pressure was only 12-in. lbs.

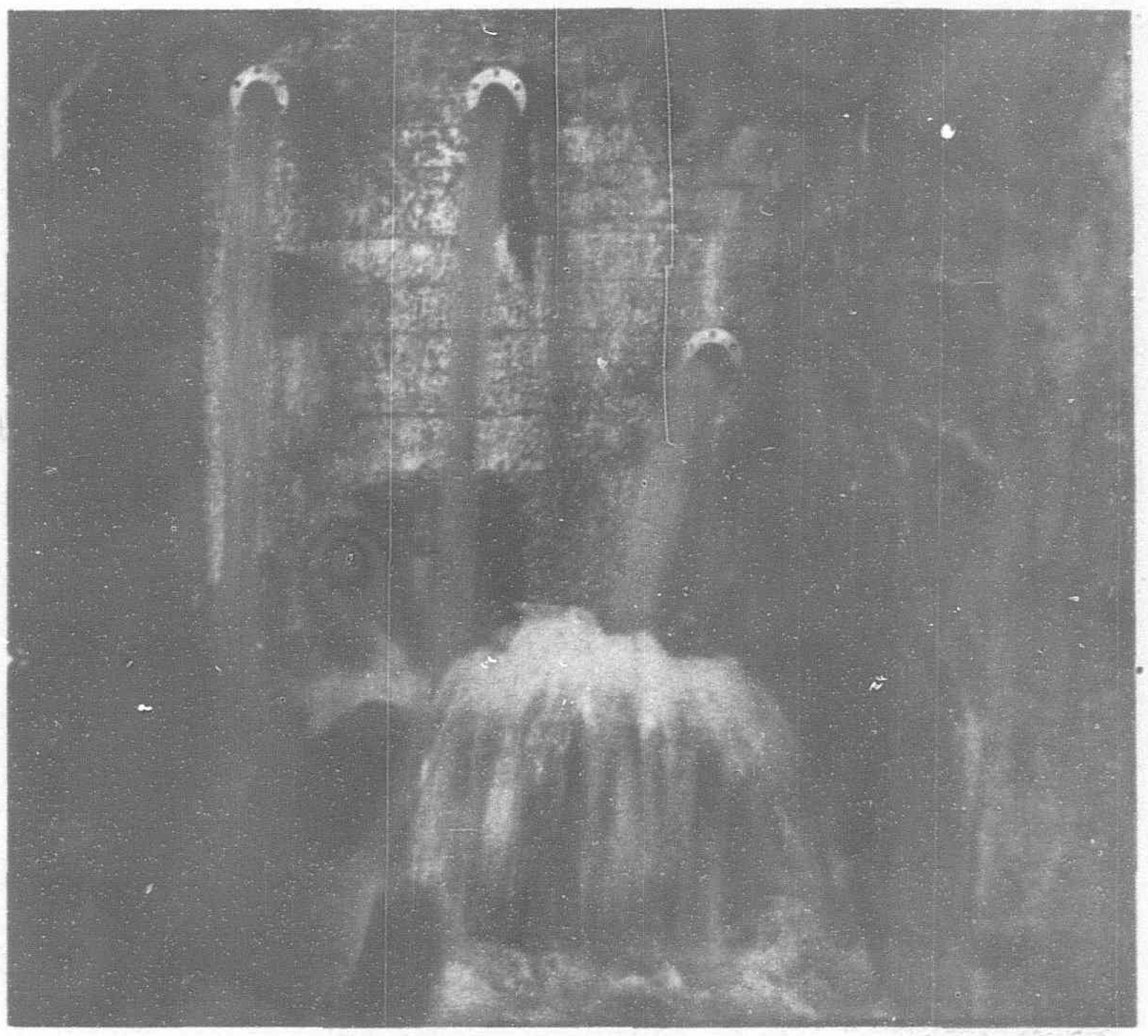
The following conclusions were drawn from conditions observed after the accident:

(*a*) Non-water-bearing volcanic lapilli can be excavated with comparative ease. Conversely, if it contains water in any volume, spouting sand and water follow excavation.

(*b*) The volume of waterflow at a given place slowly subsides in direct proportion to the lapse of time, such decrease varying with the area.



Letting Out Ground Water through Pipe-Inserted Bores in Bulkheaded Face of Concrete Lined Driftway at 11,837-ft. from West Portal, February 26, 1932



Water Draining through Steel Pipe in Bulkhead of overhead Pioneer Drift, 11,814-ft. from West Portal, September 18, 1931

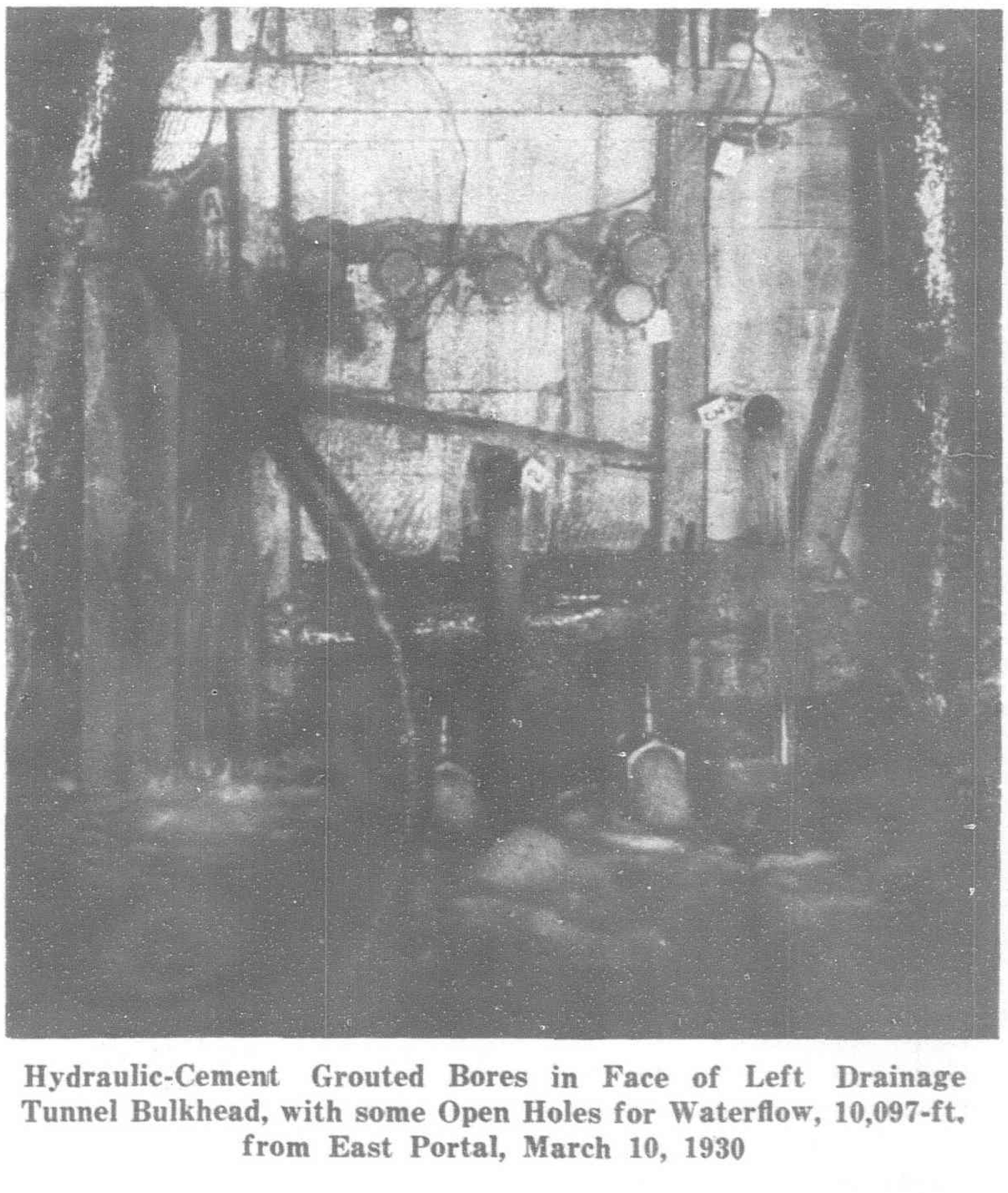
(c) A continuous, heavy flow lowers the ground-water table in the direction of its outlet, but far underground pressure is still high, though its maximum limit may be unknown.
(d) The lapilli area is intruded by less pervious tuff, andesite, agglomerate, etc., causing a partial high pressure and a variable ground-water table.

When test boring ended in February, 1926, with no water at the point where formerly torrents had flowed, the top heading was driven forward again. Toward the end of April, 1926, with this heading at 7,477-ft., the ground-water table rose as much as 3-ft. at its face, sand coming with water. Work was suspended temporarily for fear of a collapse. When compared with waterflow in the bottom heading, it was noted that the declivity of the ground-water table toward the portal was at a rate of 25-ft. for a distance of 400-ft.

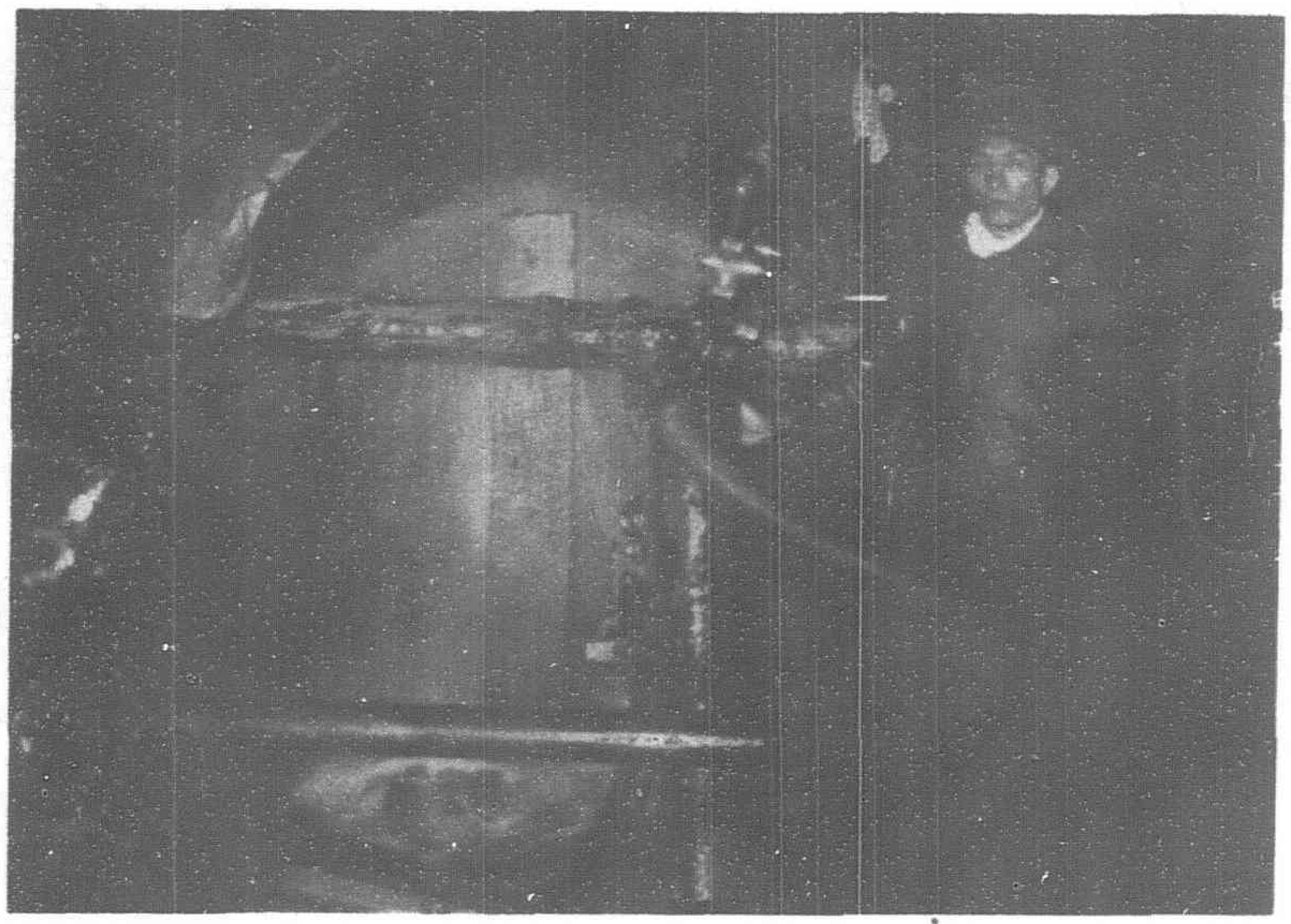
With the south drainage tunnel at 7,080-ft. in June, 1926, water which had been flowing into the bottom heading was almost diverted into this drift, and a cavity of 250 cu. yds. was found near the face of the bottom heading. Now that ground water was exhausted, there was no danger for the time being. Yet some changes had taken place in the lapilli which had been drained of water, the less resistant layers still serving for water passage. The lapilli, although detrited by water action, could now be excavated without fear of collapse.

It was decided that the best method in driving into this area was to drain ground-water into one or two drifts of the bottom or top headings, or into parallel drainage tunnels, which had already been run into water-bearing ground. An alternative was to proceed far enough so as to cause the biggest possible flow, even in the face of a cave-in; and the water level having been lowered, to excavate in comparative safety when the water had drained off. Upon this procedure, several drifts were run and horizontal boring was done from their faces, while main heading excavation was held up for investigation of the ground-water table.

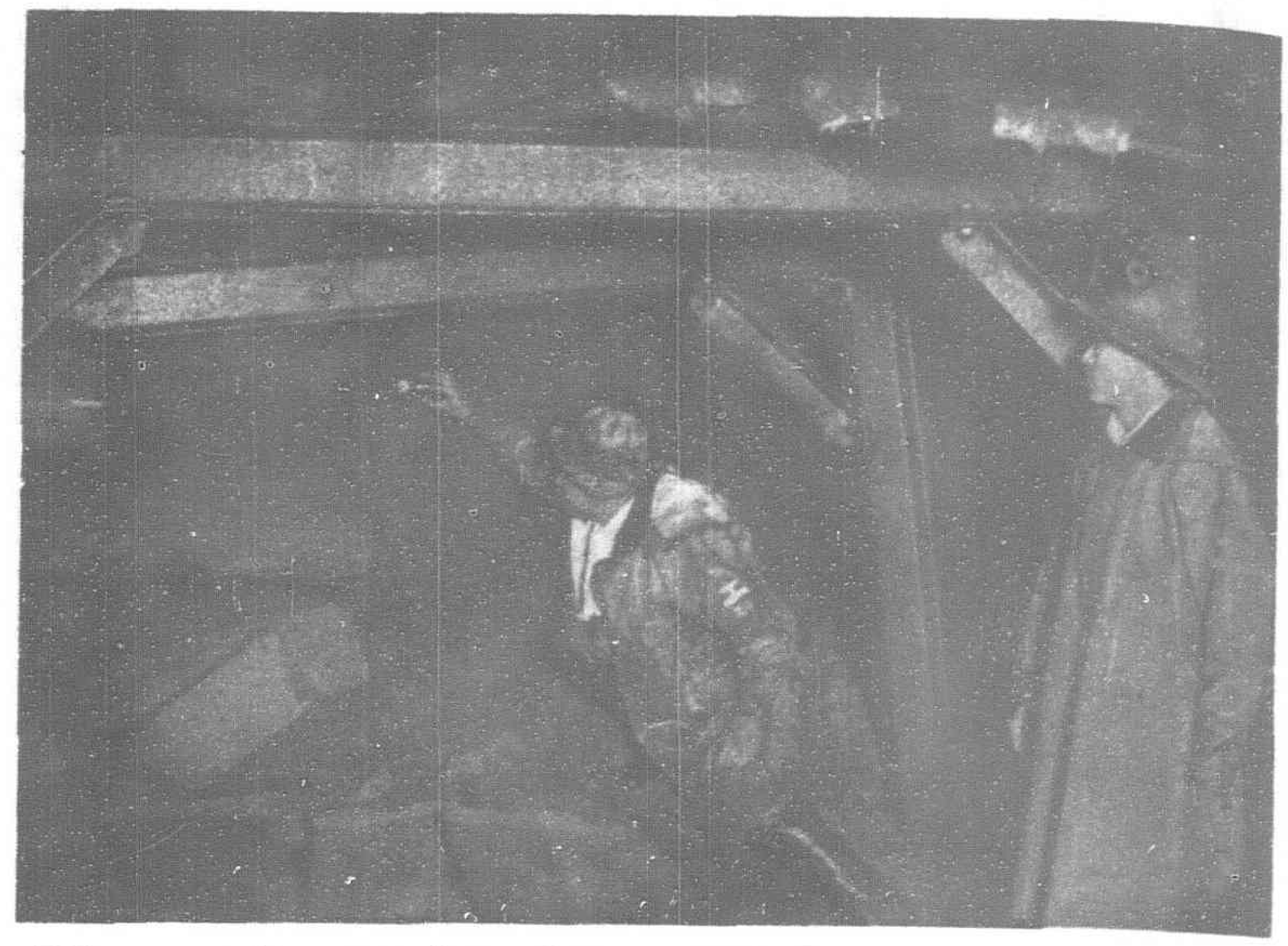
Atami, East Side; Steel Frame Deformed Under Heavy Pressure in the Clay Zone 8,930-ft. from the Portal, February, 1929



Hydraulic-Cement Grouted Bores in Face of Left Drainage Tunnel Bulkhead, with some Open Holes for Waterflow, 10,097-ft. from East Portal, March 10, 1930



High Pressure Cementation through Grout Holes in Face of Drainage Tunnel Heading, 9,188-ft. from East Portal, December 3, 1927



Where a sudden 8-ft. lateral Ground Displacement, to a horizontal Depth of 4-ft., Shifted the Main Tunnel-Heads out of Alignment—East Heading to Northward and West Heading to Southward—during severe Izu Earthquake, November 26, 1930 at 4.30 a.m.

Some drift levels were raised sufficiently so as to be able to drive through without waiting for lowering of the water table.

Although workmen were able to escape with their lives, this work was frequently interrupted by series of accidents. Inrushes of earth and water were chiefly attributable to sudden tapping of less pervious andesite or agglomerate in which the water table was often high. In June, 1927, the bottom heading at 7,800-ft. broke into numbers of huge cavities. At the face of the south drainage tunnel, the largest one measured about 3,200 cu. yds.

Entailing costly work, drift levels of some drainage tunnels were lowered, while other drifts required sealing up. Drift running through water-bearing lapilli necessitated not only spiling, which is always attended by difficulty, but sometimes a 7-ft. by 7-ft. drift had to be excavated in two to four stages, with banks of green branches to help resist falling ground. When the ground-water table rose at " a " in Plate X, work was stopped at once. A horizontal bore was sunk with a casing tube, 140 mm. in diameter, and water spouted at 9 sec. ft. through the hole. As boring continued to about 160-ft. from the face, top-heading water was exhausted.

Heroic Methods to Combat Floods

Excavating under Compressed Air.—Judging by the foregoing experience, it was concluded that the incline of ground water in the direction of the tunnel was about 1/7-1/14 and that excavation with compressed air was feasible, though the maximum ground-water pressure was unknown.

Assuming a maximum air pressure under which men could work to be 40-in. lbs., the distance that could be excavated with a single air lock would be 900-ft. for 1/10 incline of the water table and 630-ft. for 1/7.

For a distance of about 700-ft. from the air lock a drift would be run by compressed air. On reaching a certain point, air would be released and water let into the tunnel. Another drift on the opposite side would then be started. This could be advanced much farther than the first because it would require longer to reach a point in line with its heading, during which the water table would fall. Compressed air would then be released and water let into the drift. Next another air lock would be put in at the face of the first drift. Thus by alternate excavating on both sides of the main tunnel and withdrawal of ground water, the main heading could be carried forward.

Following the above procedure, the north or left pioneer drift was begun toward the latter part of September, 1927. In 245 work days this drift was advanced to 769-ft. from the bulkhead and compressed air was released. On the south or right side, another drift was begun in July, 1928. Within 255 work days a distance of 726-ft. from the bulkhead was excavated. (See Plate XI.) The water table fell and main tunnel driving continued. Then both drifts struck agglomerate and compressed air was not used.

Air locks were installed as indicated in Plates XI, XII and XIII. There were many large caves in this area and a sudden escape of air through them and resultant fall in pressure was feared. Therefore the north drain was driven around the cave zone but the south drain was begun from the main tunnel. Steps were made behind the bulkhead to the bottom surface 6-ft. lower than subgrade of the main tunnel. (See Plate XIII.) Upon

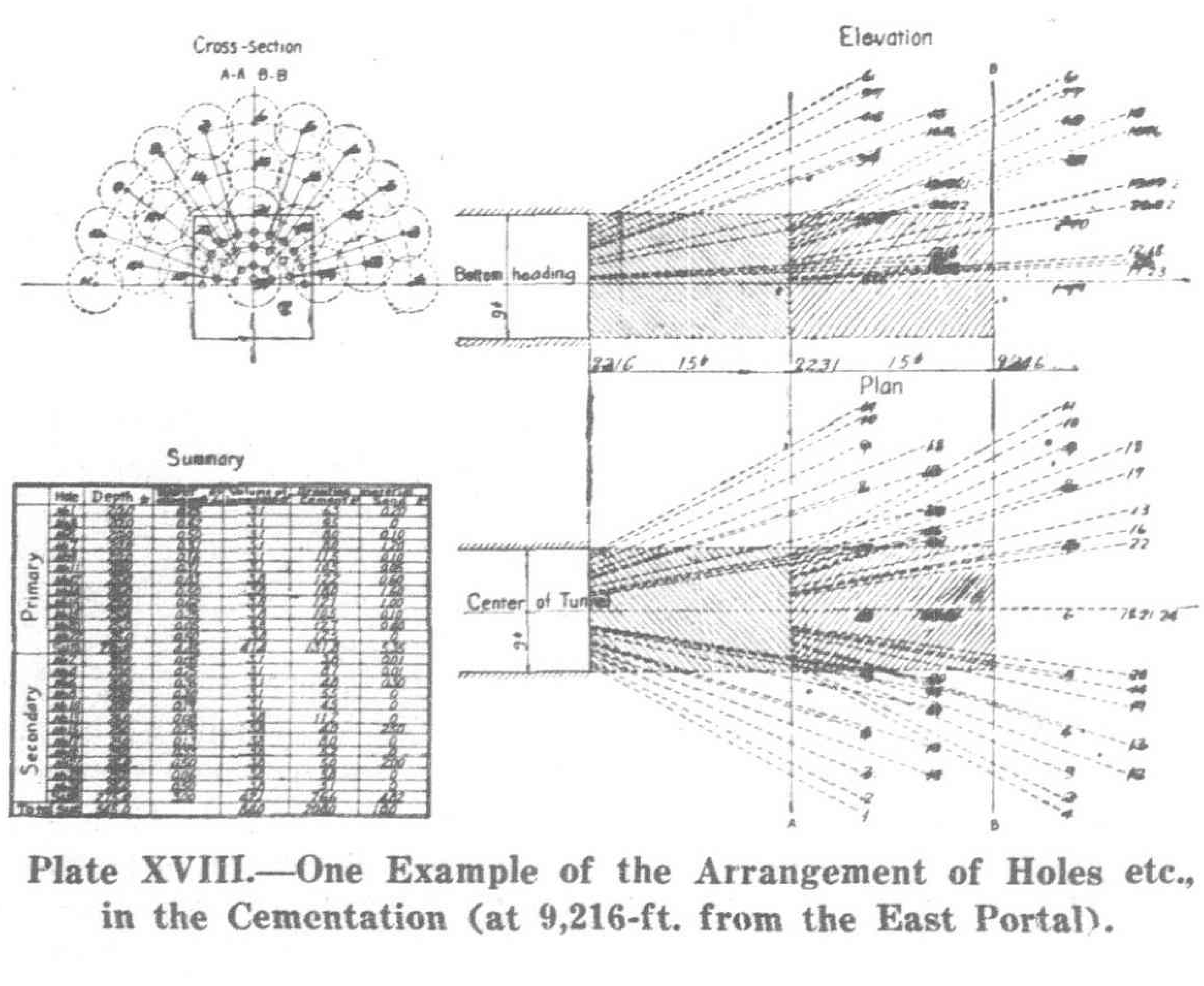
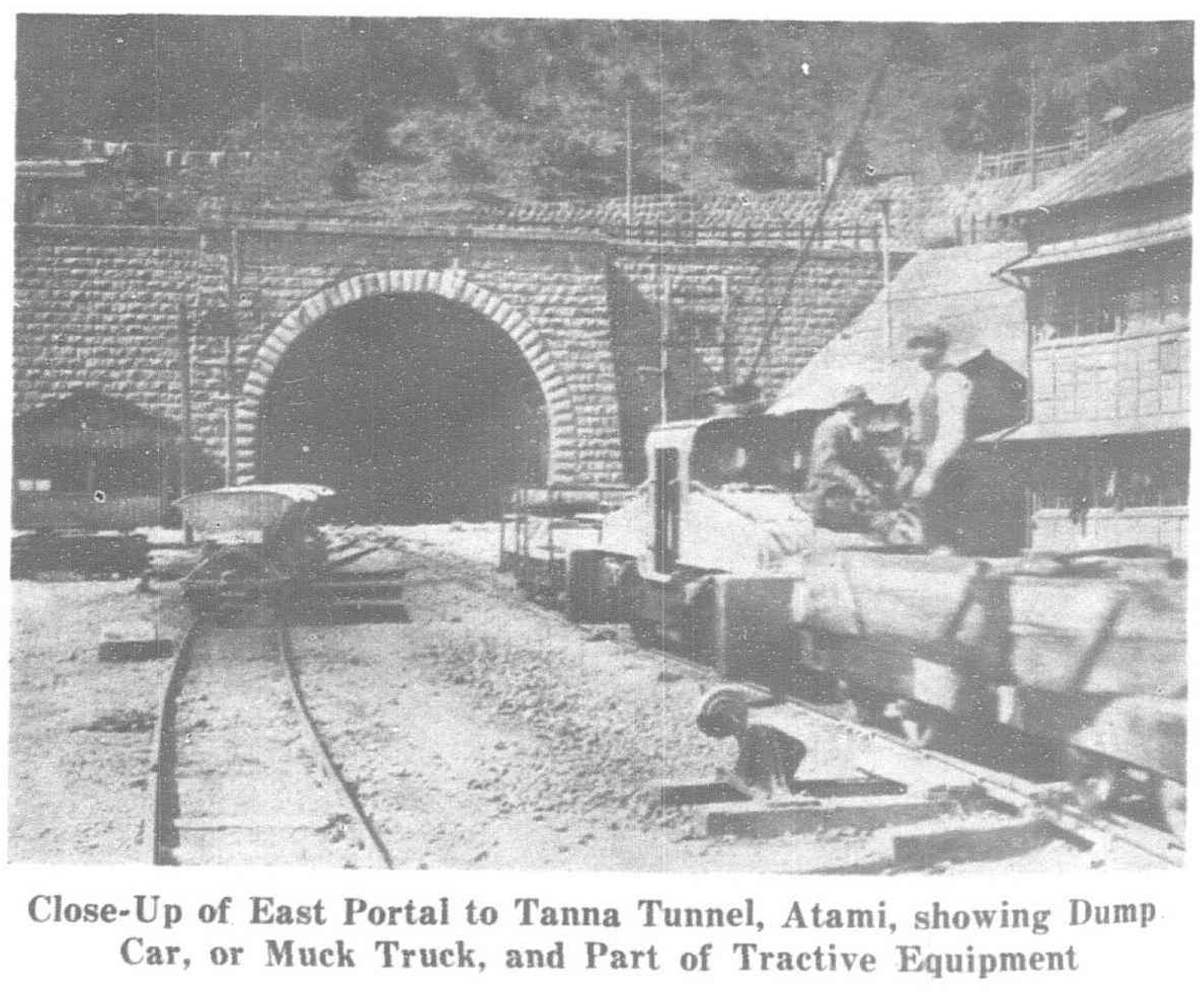


Plate XVIII.—One Example of the Arrangement of Holes etc., in the Cementation (at 9,216-ft. from the East Portal).



Close-Up of East Portal to Tanna Tunnel, Atami, showing Dump Car, or Muck Truck, and Part of Tractive Equipment

excavation, a pump to drain off water was put in near the air lock and the drift was connected with the south drainage tunnel already excavated. (See Plate XII.) The air lock was built of concrete along with some steel plates.

After having excavated under compressed air through solfataric clay on the east side in the past, it was thought that a large volume of air would not be needed for a small drift. Consequently one low pressure compressor with free air capacity of 1,350 min. ft. at 50-in. lbs. was put in. Three additional compressors with 867 cu. ft. capacity each, already installed for pneumatic machines, were provided. In the volcanic lapilli air leakage was so excessive that a total delivery of 7,760 min. ft. was required.

In the north drainage tunnel, to prevent air from leaking out, a 9-in. lining of cement-mortar and concrete reinforced the timbering, and in some places timbering was dispensed with altogether, the drift being lined with concrete instead. Left unlined, a great deal of air would escape. When more than 4-ft. was unlined under air pressure of 20-in. lbs., the volume of air was not enough for the full capacity of the compressors. Hence, immediately after excavating 4-ft. the drift surface was lined. Temporarily, cement-gum was often used to coat the drift face with mortar to check air leakage.

In the invert the bottom surface not having been lined, it collapsed for 130-ft. when air was released into the shaft. This was due to water pressure as well as earth and waterflow. Compressed air was then introduced without delay and the collapsed section re-timbered and lined. A pneumatic drill was used to bore holes for draining water through the concrete lining.

From the beginning the south drainage tunnel was lined as shown in Plate XIII. Steel pipe inserted in the lining had a gum-packed, hinged cover to make it air-tight under pressure and to release water when compressed air was shut off.

When both drains struck agglomerate (Plate XI) after passing through lapilli, compressed air was abandoned. The waterflow immediately after air-off was 14.2 sec. ft. on the north side and 11.7 sec. ft. on the south. However, the increased water volume was not as great as that given below :

	North Side	*South Side*
Total waterflow before compressed air excavation began	32.5 sec. ft.	34.5 sec. ft.
Total waterflow immediately before air-off	27.0 ,,	30.5 ,,
Waterflow into each drainage tunnel after air-off	14.2 ,,	11.7 ,,
Total waterflow after air-off ..	34.5 ,,	33.3 ,,

The above figures indicate that the water table moved back and the water volume in other drifts as well as the drainage tunnels decreased. The main-tunnel water table was lowered and the drained lapilli could be easily excavated. This area had covered a distance of more than 1,500-ft. east of 7,000-ft. from the west portal.

On June 21, 1930, a voluminous waterflow reaching 80 sec. ft. burst into the south drainage tunnel at 11,992 on the west side. It took three days for the mud and water to fill up 2,300-ft. of the drift, covering about 4,800 cu. yds. In consequence of this heavy flow, driving was discontinued in the south drift and commenced in the north side drift. To-day water is being drained out from the west portal and excavation at the main heading is practically at a standstill.

Driving through Solfataric Clay and Faults on Atami Side.—When the bottom heading at 8,264-ft. in November, 1924, struck water-bearing clay after passing through an area of andesite and agglomerate, it was feared that this solfataric formation would flow out in a semi-liquid consistency. Work was suspended for a while as this was the first real difficulty on the east side.

A drift for a by-pass was run on the south or left side to learn more about the character of the ground, and if it were possible to skirt this zone by using the drift as a passage. But water stopped this drift. Then another was run parallel to the main tunnel on the north or right side. This time a passage was effected without interference and met the center-line of the main tunnel at 8,394-ft. from the portal. Driving of the bottom heading was then pressed forward.

This zone was a fault formation 45-ft. thick in the north by-pass drift. Beyond this fault there was propylite and solfataric clay of hot spring origin intruded by a number of small faults. Excavation of the bottom heading progressed to 8,839-ft. by June, 1925. Yet the heading was under heavy pressure from clay and waterflow from the main fault which reached 3 sec. ft. Work on the heading was stopped again. Ground pressure from the clay increased and finally timbering collapsed. The usual timbering being insufficient, the heading was lined with monolithic concrete for 270-ft. (See Plate XV.)

Test borings were made from the face of the top and bottom headings, but when they struck soft clay, mud and water filled them checking completely any further advance.

A wide variety in the composition of solfataric clay led to the following conclusions :

(*a*) Immediately following excavation, ground composed of solfataric clay does not exert pressure on timbering, but as time passes it begins to swell slowly and exerts an enormous pressure upon anything offering it resistance. The cause of this swelling is not known, although it is assumed that weathering action, absorption of water and initial strain from propylitization have something to do with it.

(*b*) At first the clay is like solid rock, retaining a rocky structure, but once mixed with water, it is transformed into a semi-liquid state and begins to move in a mud flow.

(*c*) It is almost impervious to the static water-head, however high a pressure it may have.

In the fault zone near 8,300-ft. from the east portal, the water having subsided, side bottom-headings were driven, and by this method advance was made.

In October, 1925, beginning at 8,711-ft., a drift for a by-pass was run on the south side. (See Plate XV.) The object of excavating this pioneer drift was :

(*a*) To ascertain the range of solfataric clay.

(*b*) To drain off the water which otherwise might saturate the clay through faults and fissures in adjacent areas.

(*c*) If the zone were narrow to pass through it, running the drift forward to meet the center-line of the main tunnel, thus making it possible to excavate the zone from both sides.

Timbering with Steel I-Beams

Since the waterflow fell at the bottom-heading face at 8,839-ft., driving began again, continuing through the clay formation along with work on the by-pass drift. Timbering was done with steel I-beams. (See Plate XV.)

In the beginning of December, 1925, the bottom heading at 8,985-ft. encountered considerable waterflow which held up work. However, the drift was carried through badly shattered propylite and did not touch the solfataric clay. By the end of the month it reached 9,030-ft. But on the 30th of the month timbering for about 15-ft. backward from the face of the drift received heavy pressure, and the strain caused muddy water to gush out at between 5 and 7 sec. ft. Floods of earth and water increased in volume. Attempts were made to stem the flow of mud with bulkheads of sandbags and sacks of cement placed at several weak places in the drift, but to no avail so the constant flow continued at a high rate on January 9, 1926.

Debris filled up most of the driftways and gushed into the main tunnel, passing through the top heading which had penetrated the fault zone at 8,250-ft. and ran out toward the portal for about 1,000-ft. In consequence of this deluge Atami bay was discolored from the mud for many days. The debris was found to be composed of greenish-gray clay together with boulders and gravel made up of andesite and propylite. Its approximate volume came to 4,000 cu. yds.

Compressed Air Shield Driving.—When the above accident occurred, the north drain tunnel was at 8,820-ft., and it was the only drift to come near the spot where the cave-in took place. (See Plate XV.) To be able to drive safely through this zone the usual method was abandoned and instead compressed air with a segmented shield was employed.

Soon after the accident, a shield, air lock and other shield appliances were designed. The outer diameter of the shield was 9-ft., 2-in. and its length 10-ft. In order to reduce the area for excavation, the lining was made of steel segments, its inner diameter being 7-ft., 6-in. An outline of the segmented shield is shown in Plate XVII. In driving, eight hydraulic jacks preceded the shield, which had a capacity of 50 tons and a stroke of 2-ft. The jacks,

with a pressure of 2,000-in. lbs., were connected with the pressure pipe by a gum hose. In the front diaphragm there was an aperture which could be closed with square timber against any flow.

Two or three months after the cave-in, waterflow decreased and the debris settled, which made the work of clearing away masses of earth and rock possible. After cleaning out the north by-pass drift, the end of the north drainage tunnel could be reached through the fault zone. Before the shield and segments were ready for use, a test bore was sunk from the face of this drift to 210-ft. into solfataric clay, and at 190-ft. seepage water was tapped. Its pressure was 275-in. lbs.

In August, 1926, the air lock construction began and in October of the same year was commenced at 8,870-ft. from the east portal. Excavation of the clay area went ahead as expected in the beginning, but at 9,060-ft. the ground changed to shattered andesite in which shield driving was retarded. Rock in front of the shield was blasted away with dynamite. At 9,157-ft. in February, 1927, badly fissured agglomerate appeared. At the upper part of the tunnel face rock caved in with torrents of water and dynamite was used at the lower part. Air pressure was raised to 40-in. lbs. but it had no effect on the vallum waterflow of 2.5 sec. ft. The shield choked up with debris and could penetrate no further into the agglomeratic lava.

While the shield was being made another by-pass drift on the left side was begun at 8,421-ft. (See Plate XVI.) This drift soon struck an area of disintegrated fault-breccia bearing large volumes of water, and work had to stop. Several attempts to drive forward at other places failed. It was found that the fault ran north-west to south-east and met the center-line of the main tunnel at an angle of 30 degrees. At this time the total waterflow in the left drift reached about 10 sec. ft., causing a fall in water pressure in other places. This south drift met the tunnel center-line at 8,800-ft., serving as a passage to the tunnel-head.

After abandoning the shield process, test bores were drilled from the drainage tunnel in many directions. These borings revealed that the water pressure was still 275-in. lbs. but at 9,110-ft. along the main-tunnel line there was a zone of favorable andesite. Beginning from the drainage tunnel, a pioneer drift was run toward the main tunnel through good ground and there further bores were drilled to ascertain the nature of the surrounding area. It was learned that this andesite zone was flanked in by masses of bad ground, solfataric clay on the east and shattered lava bearing much water at high pressure on the west. Only after the effluxion of water had grown sufficiently less with its draining away was cement grouting resorted to.

Cement Grouting.—First it was necessary to determine whether ground conditions would permit enough cement to be grouted. No drifts hitherto had been run in the face of water pressure as high as 275-in. lbs.

At 9,120-ft. a 6-ft. concrete bulkhead was constructed and holes were drilled through it by means of a diamond-boring machine. The volume of cement milk introduced was somewhat more than the total capacity of the drill holes. The heading was advanced by the usual method when ground was found to be good for driving.

A reliable grouting machine should be able to overcome water pressure at 300-in. lbs. Apparatus manufactured by the Swedish Diamond Boring company and having a capacity of 1 cu. m. per hour under pressure of 100 atmospheres (1,400-in. lbs.) was used. Where fissures were large and cementation possible at low pressures, a Romsome Caniff mixer in connection with an air booster was employed successfully. The capacity of the grouting apparatus being too small, a hydraulic pressure pump that had been used for shield jacks was built and operated by a 20 h.p. electric motor with a capacity of 32 min. ft. Its pressure could be raised to 2,000-in. lbs. if needed. (See Plate XIX.)

According to pressure and time of grouting, the ratio between cement and water mixture was from 1 : 10 to 1 : 5. Where fissures were large cement was mixed with volcanic ash. The grout pipe was always protected by rubber packing (see Plate XIX), which by the elasticity of the rubber was attached so tightly to the grout holes as to eliminate any leakage from high pressure.

A Peiner diamond-boring machine was used first for boring circular holes to fit rubber packing. This machine, however, was used only to bore 4 to 6-ft. holes into which pipe were inserted. To drill beyond this depth a Waigh-Turbo, Model 34 rock drill did the work. Later a 6-point drill was made and bores were sunk with the rock drill instead of the Peiner machine. Generally the diameter of grout holes was 3½-in. The arrangement of holes was followed as shown in Plate XVIII. They were arranged in four concentric circles, those in the outer two circles being designed to solidify the ground laterally for about 12-ft. around the periphery of the bottom heading to a depth of 20-ft., while those in the inner circles were intended to check waterflow and to prevent rock slides at the drift face. Their depth was 25-ft.

Requiring a period of 11 months, from May, 1927 to March, 1928, the east bottom heading along a 150-ft. stretch, at 9,110 to 9,260-ft. from the portal, was driven by this grouting process.

At times the efflux of water from a grout hole only 140 mm. in diameter was 5.5 sec. ft., making difficult the insertion of pipe against water spouting at such high pressure. In very narrow seams or rock fissures the cement milk could not reach the bottom area except close to the bores.

After cement grouting was accomplished, waterflow fell from 40 to 60 per cent, thereby stemming the effluent fault-breccia and shattered lava under pressure, making it possible to drive the bottom heading through this interference zone.

Another by-pass drift, 6-ft. by 5-ft. and 27-ft. above subgrade, was begun as a pioneer to which it was diverted. Then the bottom heading was carried forward. Soon, however, high water pressure presented such an obstacle in running the pioneer drift that it was abandoned and, without resorting to cementation, the usual method was employed in driving top and bottom headings 9,260-ft. from the east portal.

Perils in Soft Ground

Running Drainage Drifts in Solfataric Clay.—Debris from the accident in December, 1925, buried already excavated sections of the tunnel but did not cause much damage despite the attendant high pressure. After many days had passed, the effluvia solidified as water drained away, and made excavating possible with its drying out.

A characteristic of solfataric clay is that on being unearthed it requires time to swell, and however heavy the ground pressure may be from this swelling, it will not fall or crumble because of its cohesive quality. Though timbering often collapsed from its irresistible movement, this clay was not found to be as dangerous as other kinds of soft ground.

Even when engineering crews became thoroughly accustomed to the treacherous nature of solfataric clay, excavation progressed with extreme caution, concrete being poured immediately along newly exposed surfaces. (See Plate IX.) In the event that the clay bore water, thus making it soft and mobile, it was feared that the mass might turn into a semi-liquid and burst unawares into the heading. Work was therefore held up continually until masses of water-bearing clay were sufficiently solidified upon draining to permit excavating operations.

As the main heading was steadily driven forward, the lining in completed parts of the parallel drainage tunnel, 60-ft. away, was deformed by unequal ground pressure due to swelling clay. This damage caused by innumerable cracks through the body of the lining necessitated its speedy re-construction.

Primary obstacles to work in the Tanna tunnel, as described above, have been unfavorable geological conditions with deluges of subterranean water. A sudden shifting of faulted ground has constituted the direct cause of accidents.

Employing the usual bottom-heading and top-cut system, it is estimated that by midsummer of 1934 the approximate 880-ft. of tunnel yet to be excavated will be driven through, according to Chief Fukujiro Hirayama, railway engineer in charge of the district construction office at Atami. The volume and pressure of underground waterflow, the number of faults or seams and the character and thickness of friction-breccia remaining is hard to determine definitely in advance. Scientific investigations have partially disclosed the nature of geological formations in the region of the tunnel. Being extremely complicated, the varied strata have been influenced by such actions as lava flow, deposit and subsidence of eruptions, erosion by water and propylitic production by hot springs. For these reasons special borings revealed little, although the peculiarities of limited areas around the cores were disclosed.

At the east tunnel-head far from Atami's hot springs, outcrops of solfataric clay (a product of dormant or waning volcanic action characterized by escaping steam, various gases and sublimates)

have been negligible west of Takiji peak and absent altogether on the west side. This seems to indicate small possibility of striking such formations in the future.

High pressure waterflow being a chief cause of difficulty in tunneling, its source has been a serious problem for years. Near the town of Mishima (see Plate I), about three and one-third miles beyond the west portal, there are four or five active springs discharging above 30 sec. ft. with a maximum of 300 sec. ft. of water. Some geologists believe the source of these underground water currents is connected closely with waterflow in the tunnel. Investigations were conducted several years ago. The results will be given further on.

A vertical bore was sunk into Tanna basin in 1923. Water gushed from the core, which was soon blocked with concrete to avoid damage to near-by farmlands. Four years later, in May, 1927, to supply water as well as to observe its pressure again, another hole was bored. This time the pressure was 20-in. lbs. and gradually lessened. It lost nearly all spurting power in January, 1929, and toward the end of July the water level was 49.3-ft. underground. To-day it is about 410-ft. beneath the basin surface. The total drop was 85-ft. in one year and eight months, and 325-ft. in four years and four months to April, 1933. The water pressure recorded on the east side at 9,160-ft. within the tunnel was 275-in. lbs., falling to 130-in. lbs. when a 130-ft. bore was sunk in February, 1929, at 9,741-ft.

At several different places, considerable flows were recorded in this vicinity, but the pressure was lower because of resistance to flow by less-fissured agglomerate. Thus the above figure could not be accepted as representing static pressure. Accompanied by failure of springs and wells in the region and surface settlement over the tunnel, it was recognized that the Tanna basin ground-water level was sinking. Water supply for the rural population and for irrigating purposes running short, measures were taken to relieve the dearth. A reservoir was planned and its construction effected.

Headway by summer, 1929, is shown in Plates XIII, XIV, XV and XVI. Not far from the Atami end where soft solfataric clay spurted out, the wall lining was finished and the arch section excavated. Within 90 days this portion of the tunnel was complete. Then, 10,000-ft. from this portal the pioneer drift and bottom heading each struck another fault. On the west side, loose volcanic lapilli having become dry, it was relatively easy to drive through. The bottom heading entered a zone of solid andesite lava and the drainage tunnel was advanced. Both were driven at a rate of about 300-ft. a month, their widening and enlargement being done by the usual method.

Fault-breccia was expected so the method of driving was to run a drift to a point about 120-ft. in front of the bottom heading. By this procedure the pioneer drift would reach a fault zone first, in case one was unearthed, and avoid danger of a main tunnel collapse. Such happening, work at the bottom heading would be stopped until the method for driving through the danger zone was decided upon.

Future construction will be easier and faster than in the past. New faults, none the less, are expected to spring up before the tunnel is finished. Water pressure has consistently fallen during the past few months and former experience better fit engineers on the job to overcome future obstacles.

Regional Water.—Diverse opinions have been voiced on the source of water flowing into the Tanna tunnel. Some believed the extraordinary flow was associated with several large springs near Mishima beyond the Otake portal. Others suggested that it came from Lake Ashinoko in the Hakone mountains not far to the north. Many streams and springs in and near Tanna basin having noticeably decreased in flow, ground water in the vicinity also is undergoing appreciable diminution. Knowing the variance of waterflow within the tunnel to be essential, four observatories, six rain gages and 21 weir stations were provided to facilitate progress of construction (See Plate XX.) Evaporation and steam-gaging were begun in June, 1927. Steam-gaging of the Kakisawa River had been taken from July, 1924 to February, 1925, with valuable results in studying the variable flux of rivers. Meteorological reports from other observatories were consulted also.

The mean annual precipitation of the region ranges from 1,200 to 2,800 mm., while snowfall is rare and seldom drifts. Precipitation consists in most part of rain, which is least during the winter months, increasing gradually in spring and summer to a peak in early autumn, only to undergo its annual diminution again. Daily precipitation ordinarily does not exceed 100 mm. Corresponding to many other regions in Japan, the yearly evaporation measured by pans is from 600 to 900 mm. This almost equals the total yearly evaporation from the land surface and the transpiration of plants.

In this region, as in other volcanic districts of Japan, porus volcanic debris devoid of much vegetation covers much of the ground surface. A major part of the precipitation therefore is absorbed, joins the ground water and reappears as springs. The volume of rain taken up by streams is relatively small, and their flow is quite equalized with variation being slight.

Before tunnel construction began, there existed a striking resemblance between the nature of stream-flows in the region of Tanna basin. This fact is evidenced by the Kakisawa River-flow in 1924, which was considerably greater than it is to-day. Its changing flux in that year was much like that of the Chitose or Hie Rivers now.

As excavation progressed, increasing volumes of water flowed out of the tunnel's east portal. Springs on the Tanna basin's eastern slope gradually subsided as a result of this ground-water depletion. Most of these springs failed. The flow of the Kakisawa and Yashita Rivers as well as the northern tributary of the Wada has notably lessened, whereas that of the Kamo, Chitose and Hie Rivers has remained almost constant. Distribution of the mean specific runoff for 1928 is given in Plate XX.

It was learned that before tunneling the mean annual precipitation was 1,900 mm., from which about 800 mm. was exhausted in evaporation and transpiration, and 1,100 mm. flowed into streams—part directly as surface flow into running water and the remainder ejected by springs after having sunk and joined ground water. The mean specific runoff was about 40 liter/sec./km^2 and the runoff coefficient about 60 per cent. The ground-water supply and its flow therefore is well balanced.

Record of Progress on Tanna Tunnel (in feet); Japanese Government Railways

Year	East End				West End				Total			
	Heading		*Lining*		*Heading*		*Lining*		*Heading*		*Lining*	
	Advance	Total	Advance	Total	Advance	Total	Advance	Total	Advance	Total	Advance	Total
1918	444	444	21	21	351	351	—	—	795	795	21	21
1919	1,598	2,042	266	287	1,938	2,289	200	200	3,536	4,331	466	487
1920	2,250	4,292	596	883	2,252	4,541	1,366	1,566	4,502	8,833	1,962	2,449
1921	176	4,468	455	1,338	348	4,889	1,367	2,933	524	9,357	1,822	4,271
1922	76	4,544	1,775	3,113	51	4,940	1,504	4,437	127	9,484	3,279	7,550
1923	1,581	6,125	1,179	4,292	191	5,131	331	4,768	1,772	11,256	1,510	9,060
1924	2,139	8,264	2,260	6,552	1,461	6,592	—	4,768	3,600	14,856	2,260	11,320
1925	721	8,985	1,275	7,827	491	7,083	350	5,118	1,212	16,068	1,625	12,945
1926	70	9,055	627	8,454	718	7,801	1,802	6,920	788	16,856	2,429	15,374
1927	133	9,188	353	8,807	30	7,831	756	7,676	163	17,019	1,109	16,483
1928	553	9,741	205	9,012	650	8,481	164	7,840	1,203	18,222	369	16,852
1929	378	10,119	274	9,286	2,348	10,829	1,144	8,984	2,726	20,948	1,418	18,270
1930	894	10,913	565	9,851	1,163	11,992	1,766	10,750	1,957	22,905	2,331	20,601
1931	280	11,193	941	10,792	—	11,992	900	11,650	280	23,185	1,841	22,442
1932	996	12,189	467	11,259	—	11,992	177	11,827	996	24,181	644	23,086
1933 (to April 1)	377	12,566	—	11,259	177	12,169	—	11,827	554	24,735	--	—

Imprisoned Waters Released

As big volumes of water flowed away with tunneling, an extraordinary decrease in ground storage resulted. Although no important change was observed in precipitation, evaporation, transpiration or percolation, the flow of ground-water into streams lessened with a resultant marked decline in annual runoff. This falling off was most noticeable in the watersheds of the Kakisawa and Yashita Rivers and the northern tributary of the Wada—the runoff coefficient having been 20 to 25 per cent in 1928. This was followed by the Hie River and the southern tributary of the Wada—the runoff coefficient in this instance being 40 to 50 per cent; whereas, no apparent change was found in the watersheds of the Chitose or Kamo Rivers. By the distribution of the specific runoff indicated in Plate XX, this will be seen.

When it was unusually rainy in 1928, the runoff coefficient was comparatively high and equalized among the rivers, but it was small the previous year during which rainfall was light.

In the watersheds of the Kakisawa and Yashita Rivers and the northern tributary of the Wada, a decided lessening of ground-water and stream flow was recorded. This fall is still evident. But, with the Hie River and southern tributary of the Wada no appreciable decrease was seen. Among several southern tributaries of the Hie a lessening of the flow was apparent, yet slight change was noted in its northern tributaries or in the Chitose and Kamo Rivers.

Neither springs in and around Mishima nor at Lake Ashinoko showed any definite variation in flow. Consequently it was concluded that waterflow in the tunnel originated exclusively with ground water in its vicinity, because the discharge reached more than twice the percolation supply maintained in the tunnel's declining outflow, which continues to grow less. This decrease is particularly noticeable near the center line of the tunnel, but more so at the bore-hole in Tanna basin. Here water pressure fell as much as 20 meters in two years—1928-1929. The more distant from the tunnel's center line the smaller the degree of decrease observed. No change was traced north of the center of Tashiro basin or south of Kurodate peak.

Since tunnel waterflow has fallen as lining is finished, it is predicted that decrease of ground-water and stream flow from now on will be most conspicuous in Tanna basin, directly under which excavation is progressing. The basin-floor being pervious, it contains sufficient water per unit volume. The bottom is about 656-ft. above the formation level of the tunnel, and the ground-water table is about 35 to 70-ft. beneath the surface. Hence waterflow in the tunnel will continue, not being exhausted before the structure's completion. The volume of water flowing from the tunnel during excavation depends primarily upon the permeability of the ground. Should a considerable sand area be struck, however, causing a heavy temporary flow—such as was had at 7,080-ft. from the west portal—then any additional flow will not carry mud in excess of that already encountered.

When the Tanna tunnel is finished water will seep from many places in the lining of the structure itself. Its volume will depend upon the composition of the lining. If it were made effectually impervious, water would stop flowing and the subterranean volume would rise by degrees on accumulation of percolated rain water, till in time spring and river flow throughout the region would revert to *status quo*. In practice, however, it is not possible to make a tunnel lining positively watertight. Therefore the volume of flow changes slowly until ultimately balanced with percolation supply.

The flow of underground streams, existing before tunneling, eventually will change their outlets into the tunnel. A balance between percolation and outflow will be maintained with no more change occurring. The flow of springs and surface streams, nevertheless, will not recover. From a topographic standpoint, the area in which no recovery occurs will be the watersheds of the Kakisawa, Hie, Wada, Yashita, Kuwahara and Fukazawa rivers. The total area covers from 35 to 40 sq. kilo. If its annual percolation is 1,000 mm., it is computed that the tunnel flow will approximate 700 to 800 sec. liters.

Facts About Manchukuo

(Continued from page 202)

the Pacific Coast defenses, and sit tight, prepared to resist the menace that our own sentimental diplomacy has brought upon us.

If we insist on taking upon our shoulders the solution of the racial problem by checking Japan in Asia, then we must not complain when the explosion occurs. For that is the logical end of our diplomacy and our present policy. Make no mistake about it. The Japanese will not meekly commit race suicide while their next door neighbors are permitted full scope to their procreative recklessness. Japan will fight for her right to exist.

The question is whether she is to fight us or find her outlet in Asia. Japan is not an enemy of the United States. She does not want to fight this country. The menace to her security comes from the other direction. She has fought two wars to find an outlet on the mainland, and each time has been tricked out of the fruits of victory. She looks ahead and sees where she may have to fight another war to preserve her hard-won rights in Manchuria. To date it has cost Japan about six billion dollars Gold to consolidate her strategic position in Manchuria and assure her security. Do you wonder that she is now determined to stand pat, and assert her right to defend herself ?

This is Japan's fight. It is not ours. Let us stay out of it. If we are wise, we will make friends with Japan and assist her in finding an outlet for her activities in Asia. If we try to stop her, if we insist that her people must remain at Home, we will simply repeat the blunders that led to the Great War. If we deny colonies or an outlet to a rapidly increasing people and compel them to remain at home, they must work in order to live. Their very necessity will compel them to work cheaper than we do. They will industrialize their country, compete with us in the markets of the world and take away our trade. This is what happened to Germany, and we know the result. Are we going to do the same to Japan ? We are already complaining that she is invading our home market with her cheaper products. If this goes on, we will witness the same propaganda that led to the explosion in Europe. Let us not make this same mistake.

The people of the Pacific Coast are looking toward the Orient for the trade that they hope will bring prosperity. You will never get anywhere if you continue to abuse and insult your best customer in Asia. The people of California have in the past shaped the policy of the government towards these Oriental problems. As you think, so will the nation think. It is up to you to take the initiative in moulding our future policy towards China and Japan. Be friendly with both countries. They need all your sympathy, your help and your understanding. Try to help these two nations to come together and settle their differences by amicable negotiations. Stop picking on Japan ; stop calling her names, and make a friend of her. Some day the United States may need the friendship and co-operation of Japan. Let us start in to cement that friendship to-day.

Japanese Telephone Communications

After careful experiments, public telephone communications between centers in Japan Proper and those of Chosen were put into operation from January 15, as had been scheduled by the Government Department of Communications.

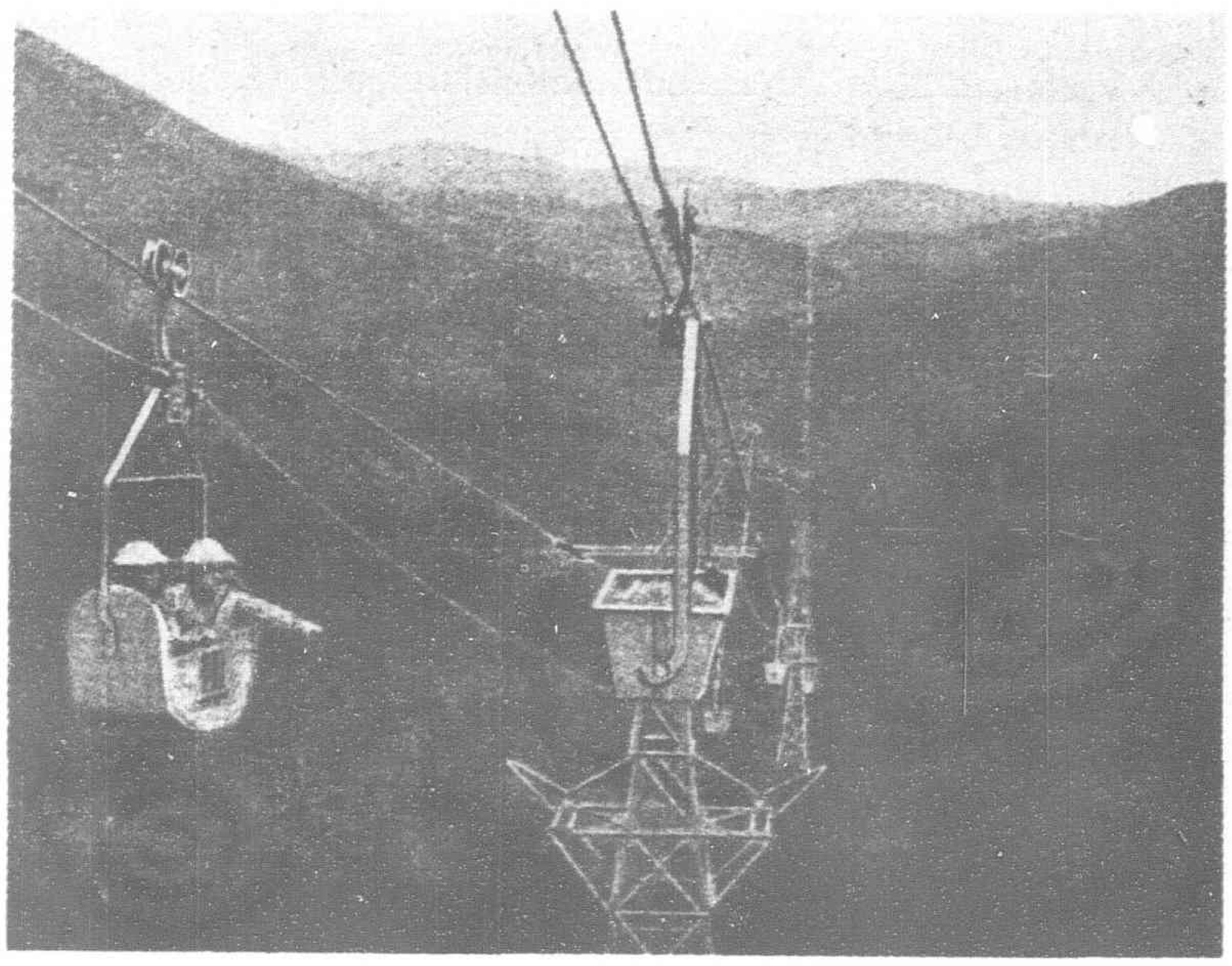
On the completion of the work of laying cables between Fukuoka (Kyushu) and Fusan (Chosen) in April next, an augmented scale of telephone communications are expected to be achieved, it is reported in official circles.

Furthermore, trial communication by telephone between Tokyo and Mukden, or Dairen, have also been successful, and the Communications Department is now planning to open this telephone communication for public service. According to the authorities, the length of this telephone wire is 2,780 kilometers—*Rengo*.

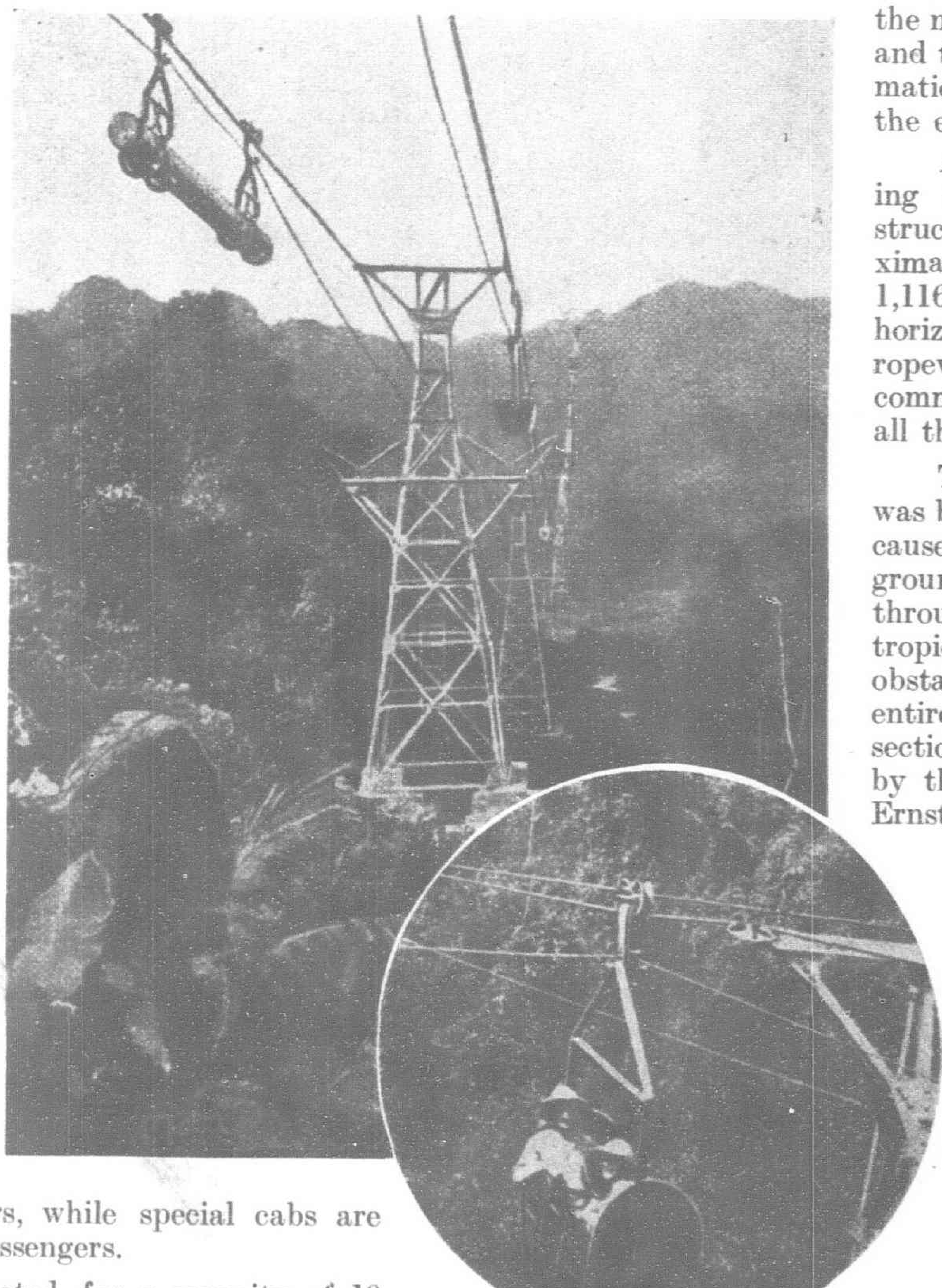
Twenty-six Miles of Aerial Ropeway in Indo-China*

By OTTO SEITZ SAARBRUCKEN

The economy of aerial ropeways as a means of transport for bulk goods of all kinds has often been demonstrated in practice, and it is just to regard them as the cheapest method of conveyance where untoward conditions of the ground render the erection of surface railways difficult. There was therefore no question about employing anything but an aerial ropeway when, in connection with the building of a new railway line in Indo-China, the problem arose of providing means for bringing large quantities of building material and food up to the various gangs of men working on the permanent way, and conveying this material across wide stretches of virgin forest and across territory which is often flooded and inaccessible for any kind of traffic.



The railway line under construction goes from Tanap to Thakhek, and the aerial ropeway of 42 km. (26 miles) length stretches over the most difficult section, between Xom-Cuc and Ban-na-Phao. The double-rope type, with carrying rope and traction rope, was chosen, as it offers the advantage of longer life of the traction rope over the single-rope type. The line is composed of six individual sections, which are interconnected at the intermediate stations, so that the cars are enabled to travel through the whole length of the ropeway line from one end to the other, while, on the other hand, each section may be operated by itself. All the intermediate stations are provided with sidings leading to store-houses in which the goods arriving by the ropeway may be stored if they are not to be carried further by the ropeway or taken away in lorries. The cars loaded with sand, gravel, broken stone, or similar material can be emptied automatically by movable discharging devices at any place along the ropeway line which is nearest to the building side to be supplied or most convenient for lorries or other conveyances to reach. Long pieces, such as logs, boards, or rails, are conveyed by two special carriers, while special cabs are provided for the conveyance of passengers.



The ropeway has been calculated for a capacity of 10 tons per hour each way. The carrying ropes have a diameter of 22 mm. (0.865-in.), the breaking load being 41.9 tons. They are made up of 360 m. (1,180-ft.) lengths, which are connected by coupling sleeves of high-grade steel, the ends being held by cast metal cones in such a manner that they cannot be pulled out. Fourteen stretching stations are provided along the line, which impart to the carrying ropes the requisite tension.

Each of the six sections of the line has its own traction rope, which is an endless wire rope of 14 mm. (0.55-in.) diameter and a breaking load of 10.8 tons. The ropeway cars are automatically attached to it, or detached from it, by means of a special grip.

The speed of travel is 2.5 m. per sec. (500-ft. per min.), the normal distance between cars 180 m. (600-ft.). When the line is in full operation, there is a total of some 440 cars under way, and about 60 cars on the sidings or in the store-houses. Before dispatch, the material to be conveyed is weighed, and the weight registered, by two automatic suspension weighers located in the end stations.

All the station towers and supporting towers are steel-frame-work constructions; the largest gradient is approximately 40 per cent, the largest span 1,116 m. (3,660-ft.) measured in a horizontal direction. Parallel with the ropeway runs a telephone line, by which communication is maintained between all the stations.

The erection of the ropeway line was beset with extraordinary difficulties, caused by the adverse conditions of the ground, inaccessibility of the territory through which the line was taken, the tropical climate, rainy season, and other obstacles to progress. Nevertheless, the entire plant, up to starting the last section into operation, was completed by the Gesellschaft für Förderanlagen Ernst Heckel m. b. H., of Saarbrücken, in barely eighteen months, while the first sections were ready for operation within a few months after starting. In the erection of this difficult installation, the contracting firm was greatly aided by the experience gained in connection with other large ropeway plants built in the tropics, such as a salt-conveying plant across the sea in East Africa.*

**Engineering Progress*

The Alluvial Tin Mining Industry of the F.M.S.*

A Story of Steady Work under Difficulties

THE history of the Federated Malay States is chiefly that of the development and progress of the Rubber and Tin Mining Industry. The conditions and welfare of these industries are of paramount importance, not only to those who have the interest of the Federated Malay States at heart, but also to the British Empire itself. Old methods have been supplanted by large bucket dredges. In general design, modern dredges only differ slightly from their predecessors, but actual experience in handling deep ground has led to important modifications which have proved successful.

Until the long period of depression set in, the leading companies of the Federated Malay States were enjoying conspicuous success, but during the past two years they have had to contend with a most difficult position and be content with smaller profits. Nevertheless, they have put up a good fight and those concerned in the management of these undertakings have good reason to be gratified at the way in which the various obstacles have been overcome.

When we consider the steady fall in consumption and other adverse factors, we must express considerable satisfaction at the result of the concerted measures taken to deal with the situation by way of restriction. There is little doubt that the restriction scheme has proved of great benefit to the companies operating in the Federated Malay States. It is interesting to note that the statistical figures for the industry during the past few months have been more reassuring, and those who have the welfare of this great industry at heart will be disappointed if, before long, the self-denial practised by the companies during the past two years does not begin to bear fruit.

Malayan Tin Dredging, Ltd.

This is one of the leading mining companies in the F.M.S. and indeed is one of the most important enterprises of its kind. With its moderate issued capital of £200,000 it has a fine dividend record. The total area held by the company is now 2,177 acres, of which there are still 1,190 acres of unworked land. The company owns five dredges, all in excellent condition, and has a joint interest in a first class power station. On account of restriction, the whole plant was closed down in August and September, 1930, and two dredges were also laid up in May of 1931, in consequence of which the yardage treated during the year ended June 30, 1931, fell from 6,143,900 cubic yards in the preceding year to 4,977,500 cubic yards, and 1,459¾ tons of tin ore were recovered against 1,529¾ tons in the year before. For the year ended June 30, 1932, the output amounting to 1,117 tons of ore, was obtained from the treatment of 4,955,800 cubic yards of ground, of which the tin ore content averaged .38 kati per cubic yard, as compared with .49 kati per cubic yard for the previous year. The sale of this output realised £87,046, being an average price of £77 17s. 11d. per ton, as against £72 6s. 6d. for the previous year. Notwithstanding restriction, the mine working costs have been kept at a strikingly low level. As was to be expected, however, the profit for the year ending June 30, 1931, was affected by the slump in prices, and at £36,661 showed a decline of £43,512. During the year ended June 30, 1932, profits have been well maintained, the total being £33,336. The dividend for this period was 16¼ per cent., as against 17½ per cent. for 1930-31, while £114,047 was carried forward. In all the circumstances, these distributions must be considered highly satisfactory. An outstanding feature of this company is its strong financial position. Its investments, even at current figures, together with cash in hand, amount to approximately £300,000.

Southern Malayan Tin Dredging, Ltd.

This company has four modern dredges at work on its area of 2,052 acres. During the year ended June 30, 1932, the tonnage of tin ore won showed a heavy contraction when compared with the figures of the previous year, due entirely to the working of the restriction enactment. 4,060,500 cubic yards of ground were treated, of which the average of tin ore content was .46 kati per cubic yard, as compared with an average of .44 kati per cubic yard for the previous year, when 7,776,500 cubic yards were treated. The output amounted to 1,129 tons of tin ore, which realised £87,701, being an average price of £77 13s. 7d. per ton, as against an average price of £71 12s. 2d. per ton for the previous year. As a result of the limited production, the profit for the year ended June 30, 1931, was £43,424, while for the year ended June 30, 1932, the profit was £28,372. The total dividends for the latter period were 7½ per cent., which compares with 10 per cent. for the previous period. At June 30, 1932, the unworked area measured 1,759 acres, and the company is assured of a long life.

An event of importance to the company during the past year was the acquisition of an adjoining property previously owned by Teja Malaya Tin Dredging Co., and extending to approximately 1,600 acres. The property was acquired at a price which compared very favourably per acre with that paid a few years back for land of a similar character. The acquisition of this new land will increase the area now owned by the Southern Malayan Tin Dredging, Ltd., to some 3,700 acres, and will make the undertaking one of the largest tin dredging properties in Malaya.

Southern Perak Dredging, Ltd.

The capital of this company is £150,000, and during its 12 years of existence, it has paid in dividends over £200,000. The property was being worked by two dredges, but owing to restriction, the output for the year ended June 30, 1932, was obtained with one dredge working part time only. During the year ended June 30, 1932, the quantity of ground treated was 989,400 cubic yards, the average value of the ground being .57 kati per cubic yard, as compared with 2,720,600 cubic yards averaging .3 kati per cubic yard for the previous period. The actual output amounted to 338 tons of tin ore, which realised £27,472, being an average price of £81 5s. 7d. per ton, as against £72 8s. 7d. per ton for the previous year. The profit for the year ended June 30, 1932, was £4,586, and adding the balance brought forward there was a total credit of £19,160. The directors repeated the dividend of 2½ per cent. paid for 1930-31, and carried forward a balance of £15,410. The company commenced the year on a production of 75 per cent. and this figure had to be brought down by various cuts to 33⅓ per cent. on June 1, 1932, while a month later it was further reduced to 25 per cent., at which rate it is still running. Roughly, this means only half time work for the operating dredge. These drastic cuts resulted in an increase in the working costs, but, on the other hand, the value of the ground worked was much higher than in the previous year, and the actual cost calculated per ton of ore proved to be lower by £10 per ton.

Tronoh Mines, Ltd.

This is one of the oldest, most successful and best known of the companies working in Malaya. Its property has a total area of 4,724 acres, part of which is situated at Tronoh and part at Tanjong Tualang. The company owns five dredges. The original Tronoh area was being worked by two dredges, and the Kampar section at Tanjong Tualang also by two dredges, while the company's latest dredge is ready to commence operations as soon as conditions permit. Owing to restriction, the working of the dredges has been much interrupted and during 1931 only the two dredges at the Kampar section were operated throughout the whole of the year. The total output of tin ore during 1931, including the ore

* *The Mining Journal.*

produced by tributers, was 1,488 tons. Of this total the dredges produced 870 tons, against 834 tons in 1930 and realised an average of £72 12s. 2d. against £91 16s. 1d. For the year 1931, the profit, including income from investments, was £30,292, against £27,487 for 1930. Dividends equal to 5 per cent. were paid, and the sum of £21,919 was applied to depreciation, leaving a balance of £49,605 to be carried forward. Only three of the company's dredges were at work at any time during the period. No. 2 at Tronoh worked for eight months and as we pointed out above, the two dredges (Nos. 4 and 5) at Kampar for the whole twelve months. The No. 2 was closed down when restriction was increased from 25 to 60 per cent. as it was found that the whole quota could be obtained more economically by Nos. 4 and 5. During this period costs at Kampar amounted to 3.33d. per yard, against 3.13d., but the yield was also higher and the cost per ton of ore produced was only £47.74, against £62.56 in 1930. The company possesses valuable interests in other mining companies, including shares in Sungei Besi, Sungei Way, Ayer Hitam, Pengkalen, Idris, Kent, Kepong, Southern Tronoh, Kinta, Malayan Tin, Southern Malayan, Pari, Rambutan, Tekka and Gopeng, besides one-third interest in Puket Tin Dredging. The latter undertaking has been formed to work a valuable tin property in Siam, the Tronoh Co. holding one-third interest and the Waihi Gold Mining Co. the remaining two-thirds. When the dredge is at work on this property, it is believed that profits should be made on tin at low prices.

Southern Tronoh Tin Dredging, Ltd.

Formed in 1927, this company acquired from Tronoh Mines, Ltd., 600 acres at Tanjong Tualang, Perak. The first of its dredges commenced opening out operations in February, 1929, and the second dredge started in May, 1929, and commenced recovering tin ore in September. Operations have been handicapped only due to the restriction policy, with the result that the present production does not reflect the full earning power of the dredges, the output for the year 1930 being 566 tons of tin ore, of which No. 1 dredge contributed 348 tons and No. 2 dredge 218 tons. During 1931 the output amounted to 441 tons, and realised an average of £71 6s. 8d., against £90 0s. 8d. Since June, 1931, only one dredge at a time has been in operation. The value of the ground worked was the same as in the previous year, .66 lbs., but owing to the abnormal conditions, costs were somewhat higher, averaging 4.14d. per yard. For the year to December 31, 1931, after providing £5,000 for depreciation, there was a profit of £2,837. The company paid a dividend of 2½ per cent. in July, 1930. On the return of normal conditions, and with a fair price for its product, the company should, later on, enjoy considerable success.

Idris Hydraulic Tin, Ltd.

This company's property is situate in the Kinta Valley, and is being worked by monitors, elevators and gravel pumps. Work is at present directed to two sections known as Batu Karang and Kranji. The output of tin ore for 1931 was 312 tons, as compared with 353 tons for 1930. The working profit of the mines from all sources during the period amounted to £1,465, as against £8,690 during the previous year. It should be noted, however, that the production of tin ore under the restriction enactment was limited to 75 per cent. of the company's assessment from March to August, 1931, and to 40 per cent, during the subsequent quota periods. The restriction was effected mainly by the treatment of the lower grade ground at the Batu Karang section of the mine, and also by the complete cessation of production as necessary. The amount realised from the sale of tin ore during 1931 was £21,-402, representing an average price of £68 11s. 4d. per ton, as compared with £80 1s. 8d. per ton for the preceding year. The balance at credit of profit and loss account at December 31, 1930, was £15,273, from which had to be deducted the loss for the year to December 31, 1931, leaving a balance of £13,281. The directors transferred £3,000 to reserve, leaving a balance in hand of £10,-281. In respect of 1929 four dividends of 5 per cent. were paid, while in respect of 1930 a dividend of 2½ per cent. was paid in March. During the past year the company has been working on much the same lines as 1931.

Ayer Hitam Tin Dredging, Ltd.

This company, with its moderate issued capital of £180,000 owns 1,032 acres and possesses one of the largest dredges in the Federated Malay States. Digging operations commenced in June, 1929, but the payable area was not reached until some months later. The first return was made at the end of November, 1929, and the total output to June 30, 1930, was 562.7 tons of tin ore which realised £59,778, or an average of £106 4s. 8d. per ton. A maiden dividend of 2½ per cent. was declared in June, 1930, and then dividends of 2½ per cent. were paid in January, March, June, September and December, 1931, and March, June and December, 1932. During the year ended June 30, 1931, the dredge treated 2,287,829 cubic yards for a recovery of 970 tons of tin ore which realised £73,330 or an average of £75 11s. 6d. per ton. Working costs at 2.9d. per cubic yard made the company one of the cheapest in the F.M.S. During the year ended June 30, 1932, owing to curtailment of production under the restriction agreement, it was only possible to work the dredge for broken periods, and during four months of the year, dredging operations were completely suspended. During this period the dredge treated 1,365,906 cubic yards, and the output amounted to 675.69 tons realising £54,120 or an average price of £80 1s. 11d. per ton. During this period no trouble was experienced with the dredge, but the effect of the drastic restrictions carried out during the year was reflected in the figures of the report. The yardage decreased by over 40 per cent. compared with the previous year. That year cannot be taken as a fair basis for comparison owing to various schemes of restriction having been adopted during that period. The profit secured for the year to June 30, 1932, was £21,055, and dividends were paid for the year amounting to 10 per cent., while the balance of £9,015 was carried forward. The return to the shareholders must be regarded as most gratifying in the circumstances.

Sungei Besi Mines, Ltd.

During recent times, the position of this company has materially altered as a result of the commencement of operations on the Sungei Besi village area. The old property during 1930 produced 499 tons tin ore value £49,868, the average price realised per ton of ore being £100, as against £132 per ton in 1929. The output for 1931 was 482¾ tons and realised an average of £71 9s. 4d. In this year the accounts had the benefit of £6,915 realised by ore sales in 1930, but not brought into the account by the end of that year. For 1931 the profit, after providing for ordinary depreciation, was £7,561. as against £5,155 for 1930, and a balance of £32,051 was brought forward, making a total of £39,612. Out of this the directors applied £17,588 to writing down the hydro-electric works account to £80,000 and to reducing other accounts, leaving a balance of £22,024 to be carried forward. Owing to the restriction enactment, it was not possible to carry out a normal programme of mining. The average recovery was 3.78 lbs. per yard, as compared with 6.84 lbs. in 1930. The installation of the Government line to connect up with the company's hydro-electric supply at Sungei Besi was completed in March, 1931, and the Government commenced taking surplus power on April 1. On January 3, 1933, the company announced that an agreement had been arrived at for the sale of the hydro-electric installation to the F.M.S. Government at a price of £200,000, Sungei Besi Mines, Ltd., being in addition entitled to receive four million units of electricity per annum free of charge for 20 years. The company is interested in Pelepah Tin Dredging, Ltd., the whole of the capital with the exception of £20,000 being subscribed by Sungei Besi Mines, Ltd. Below we give particulars of the Pelepah property, which is undoubtedly a valuable one, and with a reasonable price for tin should eventually prove a good source of revenue to the Sungei Besi undertaking.

Pelepah Tin Dredging, Ltd.

This company was formed in March, 1931, and acquired from Sungei Besi Mines, Ltd., a sub-lease of alluvial tin mining property with an area of 1,092 acres near Kota Tinggi, Johore. The properties were tested by bores, under the direction of Mr. G. W. Simms, the general manager of Sungei Besi Mines, Ltd., and on a selected area of 974 acres there was an estimated yardage of 49,682,000 cubic yards, with an average value of 0.49 kati per cubic

yard. In addition there are a further 118 acres of lower grade ground containing about 6,000,000 cubic yards. The company's dredge was successfully launched on December 7, 1932. It will have a monthly capacity of 250,000 cubic yards, and with the metal at a fair price satisfactory profits should be earned as low working costs are assured.

Sungei Way Dredging, Ltd.

The area held by this company covers 1,177 acres in the Selangor district, of which 925 acres have been proved by boring to contain 83,845,025 cubic yards of ground of an average value of 0.56 kati per cubic yard. A dredge commenced work in October, 1926, followed by a second dredge in December, 1928, while in October, 1930, a third dredge started operations. The results achieved have been decidedly encouraging, the output during the year ended June 30, 1930, having been 977 tons tin ore, value £96,884 or £99 3s. 1d. per ton, while costs amounted to £45 12s. 5d. per ton. Dividends aggregating 15 per cent. were paid, bringing the total dividends paid since the company commenced dredging up to 60 per cent. With the new No. 3 dredge in commission increased returns were obtained during the year ended June 30, 1931, the tin ore produced amounting to 1,119 tons, although operations were interfered with by restriction of output. The results during the year ended June 30, 1932, disclosed a falling off due to the same cause, the output of tin ore totalling 614 tons. The sales of ore during this period realised £44,348, being an average value of £72 3s. 11d. per ton. Owing to the restriction of output, No. 3 dredge was idle during the whole of the year and Nos. 1 and 2 worked for approximately only two-thirds of the year in all. After the further reduction in the quota, it was considered that the company's quota could be more economically produced by one dredge only, consequently No. 2 dredge was stopped on May 1, 1932. When the situation is brighter this company should do well, for with its large unworked area it has sufficient to keep its three dredges at full work for quite seventeen years.

Kent F.M.S. Tin Dredging. Ltd.

Dredging commenced on this property at Kuala Lumpur, in the F.M.S., in June, 1928, and results were satisfactory, while, despite depressed markets and the low price of tin, the company succeeded in reaching the dividend paying stage, with distributions of 12½ per cent. for 1928, 25 per cent. for 1929 and 5 per cent. for 1930. During 1930 the ground treated was 1,558,960 cubic yards, a decrease of about 256,120 cubic yards when compared with the previous year, this decrease being partly due to a greater quantity of clay encountered, and to stoppages to regulate production, but although the yardage treated showed a decrease it was possible to reduce the average cost of treatment to 2.99d. per cubic yard. Production of tin ore during 1930 was 379½ tons, as compared with 573½ tons during 1929, while during 1931 the total was 306½ tons, realising an average of £62 8s. 2d. per ton, against £79 13s. 10d. in the previous year. Notwithstanding the reduced scale of work, the cost per yard was reduced from 2.99d. to 2.73d., but the grade treated was lower, averaging 0.44 lbs., against 0.55 lbs., and the cost per ton of tin ore produced was higher at £57 14s. 1d., against £51 3s. 6d. Operations in the year to December 31, 1931, resulted in a loss of £800 and deducting this from the amount brought in, there was a balance of £3,778 to be carried forward. The balance of the share premium account, £6,694, was applied to writing down plant and machinery. The output was, under the restriction act, limited to 75 per cent. of the company's assessment from March to August, and to 40 per cent. during the subsequent periods. During the last few years the dredge has been working the lower grade side of the property, and under normal conditions would enter ground of considerably higher value, but with restriction in force little advantage would be gained, and satisfactory arrangements were made under which the dredge was temporarily closed down as from March 1, 1932, and the company's quota is being produced by Gopeng Consolidated on a profit sharing basis.

Gopeng Consolidated, Ltd.

In spite of the difficulties which have been experienced by the tin industry during the past couple of years, this company has been able to maintain a good standard of output and keep its working costs at a level which has enabled it to face the fall in the price of tin with complete confidence. This undertaking has the proud distinction of being the first to work alluvial bearing ground in the F.M.S. by means of hydraulicing and its dividend record has been a particularly good one. At the present time, the company remains one of the cheapest producers of tin ore in the world, and its achievements in this respect have been very notable. During the first three months of the financial year ended September 30, 1931, the output was curtailed in accordance with the voluntary undertaking given to the Tin Producers' Association. From March to August, under the tin restrictment enactment, production was limited to 75 per cent. of the company's assessment and to 40 per cent. during September. As a result of restriction, the yardage of 1,705,600 treated during the financial year showed a decrease of 391,500 cubic yards as compared with that of the year 1929, which was unaffected by restriction. The tin ore content was 0.71 kati as compared with 0.73 kati, the average of the previous year. A satisfactory feature was the further reduction in working costs from 2.96d. to 2.67d. per cubic yard treated, the lowest figure ever attained by the company. The working cost of production was also again reduced.

The company has enjoyed an enviable dividend record, recent distributions having been 20 per cent. for each of the years 1920-24, 1924-25, 1925-26, 25 per cent. for 1926-27, 16½ per cent. for 1927-28, 20 per cent. for 1928-29, 13¾ per cent. for 1929-30, while in respect of the year ending September 30, 1931, 1⅜ per cent. was paid in January, April, July and September. For the year ended September, 1932, the dividends have been January 7 3d. per share, April 7 3d. per share, July 7 3d. per share, September 30 3d. per share.

The report for the year ended September 30, 1932, will be available in March and, according to cabled returns from the mine, the output was 311 tons tin ore, the estimated working profit being approximately £20,000. The company is in a strong financial position, and although it has had to curtail its output during the past two years owing to the restriction scheme, it is in a much happier position than many other undertakings owing to its being a low cost producer.

Tekka, Ltd.

This company was originally formed in 1907, and after a successful career in which it paid dividends and bonuses aggregating 77s. 6d. per share, in addition to certain interests in Tekka Taiping, was reconstructed in 1920 for development purposes. The present company, like its predecessor, has secured very satisfactory results notwithstanding restriction and the slump in the price of tin. During the year ended March 31, 1931, the hydraulicing plant treated 962,450 cubic yards, a decrease of 35,150 cubic yards when compared with the previous year, but owing to a slightly lower grade of ground, the output was 457½ tons tin ore, as against 540 tons. During the year ended March 31, 1932, the hydraulicing plant treated 835,100 tons, and the output was 341 tons. The working cost per cubic yard for this year was reduced by 2.95 cents. The reduction in the output and in the number of cubic yards of ground treated was, of course, due to the compulsory restriction. The dividends for the last five years have been 1s. 10½d. per share for 1927-28, 1s. 6d. and 6d. bonus for 1928-29, 1s. 6d. for 1929-30, 10½d. for 1930-31 and 6d. for 1931-32. During the past year the output has again been curtailed and for the nine months ending December 31, 1932, the production was 123 tons tin ore, the estimated working profit being £1,942.

Tekka-Taiping, Ltd.

This company installed a new dredge, No. 3, in March of 1930, and it then had three dredges in operation which, under normal conditions, would have resulted in a large increase of output. The output for the year ended October 31, 1930, was 513 tons tin ore, a decrease of 20 tons when compared with the previous year, the returns being adversely affected by drought and the working of lower grade ground. The cost of production of one ton of metal was £108, an increase of £15 on previous years, and there is no doubt that costs would have been much lower and the output higher if it had not been for restriction. The output for the year ended October 31, 1931, was 590 tons, but while there was thus an increase in output, there was a decrease of £4,743 in

value. The working profit for 1929-30 was £13,097 and a dividend of 3d. per share was paid. For 1930-31 the working profit was £12,077. This time, however, the directors, in view of the conditions, did not declare any dividend but decided to carry forward the surplus in hand of £20,383. For the year ended October 31, 1932, the production of tin ore was 263 tons, and the estimated working profit £5,166. The ground remaining to be worked will give a life of 14 years, and with an improvement in the position the company should do well.

Pengkalen, Ltd.

This company's property covers 1,083 acres near Lahat, F.M.S. and has been worked by two dredges, the second dredge starting work in September of 1928. During the year ended September 30, 1930, the No. 1 dredge treated 826,750 cubic yards or a recovery of 188.8 tons tin ore, against 902,140 cubic yards and 378 tons the previous year, the decrease in the yardage treated being due to difficulties encountered in crossing the river and Government road. This was also responsible for an increase in costs which amounted to 4.92d. per cubic yard, as against 3.99d. in the previous year. There was, however, an increased yardage treated by the No. 2 dredge and a decrease in costs, a total of 1,816,420 cubic yards being treated for a yield of 522¾ tons, as against 1,600,-130 cubic yards and 467 tons during the previous year. During the year ended September 30, 1931, the No. 1 dredge treated 854,-370 cubic yards, and the No. 2 dredge treated 1,570,290 cubic yards, the output being respectively 204 tons and 524 tons. The year's results were, of course, affected by participation in the scheme for the restriction of output, and the total working profit amounted to £25,813, compared with £33,785 in the previous year. After various adjustments and paying dividends amounting to 10 per cent. on the preferred ordinary shares, there was left a sum of £21,913 to be carried forward. It is interesting to record the dividends of previous years as it will give some idea of what the company is capable of under normal conditions. The dividend paying stage commenced in 1912-13, and with the exception of the two following years, distributions have been maintained since. For 1925-26 32½ per cent. was paid on the preference and 22½ per cent. on ordinary; 1926-27, 32½ per cent. on the preference and 22½ per cent. on ordinary; 1927-28, 35 per cent. on preference and 25 per cent. on ordinary; 1928-29, 50 per cent. on Preference and 40 per cent. on ordinary; 1929-30, 15 per cent. on preference and 5 per cent. on ordinary; 1930-31, dividend of 10 per cent. on preference only. In order to reduce the cost of production to the minimum possible under existing conditions, curtailment is being effected by the stoppage of No. 1 dredge and the periodic closing down of No. 2 dredge when the quotas are exhausted. The company, in common with other low cost producers, is severely handicapped by artificial restriction, but it should continue to yield profits under present adverse conditions and is in a strong position to take full advantage of any improvement in the future. The company's area remaining to be worked assures it of a life of at least a quarter of a century.

Kinta Tin Mines, Ltd.

In addition to its tin mining property at Kinta, F.M.S., this company owns half share of the Sanglop Rubber Estates and also a large holding in Tanjong Tin Dredging, Ltd. The Kinta tin mine is an open-cast working, the tin ore being recovered by hydraulicing. The company expended about £40,000 in renewing the Singu pipeline, which brought about a reduction in costs and these are now down to the low figure of 3¾d. per cubic yard. During 1930 the output was 288 tons tin ore, which realised an average price of £85 15s., against £125 10s. the previous year. A dividend of 5 per cent. was paid against 20 per cent. for 1929. During 1931 257 tons of tin were recovered which yielded a mine profit of £5,216, as against £8,918 in 1930, the lower figures being chiefly due to the price of the metal and restriction. During the past year the mine produced its own quota of 120 tons of tin ore and a further 43 tons were produced in respect of the joint production arrangement with Tanjong Tin Dredging, Ltd., the total mining profit being approximately £2,570. The company owns 1,060 acres and is thus assured of a long life. It has already been in existence for 32 years, during which it has paid substantial dividends and it is likely to repeat its past achievements when times become more propitious.

Tanjong Tin Dredging, Ltd.

In the first six years of its existence, this company was very successful, paying dividends of 25 per cent. for 1928, 20 per cent. for 1929, and 5 per cent. for 1930. The property covers some 596 acres in the Perak district, and only a small portion had been worked to December 31, 1930. The company possesses a dredge with a capacity of 120,000 cubic yards monthly and during 1930 it treated 1,061,030 cubic yards for a recovery of 324 tons tin ore, as compared with 372 tons in 1929, the decrease being due to restriction. During 1931 the number of cubic yards treated was 849,-400 and the output was 329 tons. As a result of the restriction enactment, the company's dredge was idle for long periods, and thus led to the total yardage showing a decrease of 211,630 cubic yards, while the cost per cubic yard was increased from 4.14d. to 4.33d. It is satisfactory to note, however, that by a joint production arrangement with Kinta Tin Mines, Ltd., it has been found possible to keep maintenance costs at a minimum while the dredge is closed down. The accounts for 1931 disclosed a profit of £7,053, and after providing for depreciation and income tax account, the net surplus was £1,759. With the amount brought in, there was a total available of £5,948, and after transferring £3,000 to a reserve fund, there was left to go forward the sum of £2,948. The operations for 1932 resulted in a mine profit of approximately £2,597.

Petaling Tin, Ltd.

The story of Petaling Tin, Ltd., during the past few years is a striking testimony to the importance of being a low cost producer, and the tremendous advantage of capacity and low working costs is clearly revealed in the fact that this company is able to pay a dividend of 20 per cent. for the year ended October 31, 1932. Before, however, giving some of the figures for the past year, it will prove of interest if we detail a portion of the history of this successful mine in recent times. During 1928-29, 77 acres were dredged, making a total of approximately 199 acres since the company commenced mining operations. It was then estimated that the company's areas, comprising approximately 2,038 acres, contained a further 115½ million cubic yards of payable ground and 28 million cubic yards of ground which, it was anticipated, would probably prove payable. This represented a proved life of at least 19 years, with a further probable life of 4½ years. In that year it was decided to instal a dredge capable of treating an average of 220,000 cubic yards and the cost of bringing this dredge to the producing stage was about £100,000. This new dredge fully justified its installation after it commenced production at the end of December, 1931. The dredge, which is of British construction, has a very large capacity and is equipped throughout with the object of obtaining the maximum of efficiency and economy. In view of the introduction of the restriction enactment, which virtually meant the survival of the fittest, the installation of this dredge on the Petaling tin property proved a very timely development. The restriction policy has proved a heavy handicap to the Malayan tin industry on account of the numerous small mines in Malaya as compared with the rest of the world, but as the Petaling possesses a number of units of varying capacities it has been enabled to cope with the restriction schemes. The assessment of the mine in respect of its numbers 2, 3, 4 and 5 dredges was 60,550 pikuls per annum as from January 1, 1932, an assessment of 23,520 pikuls having been granted for the No. 5 dredge from that date. The strength of the company's position lies in the fact that the No. 5 dredge is capable of producing the whole of the company's quota with the utmost economy and at an exceedingly low cost of production.

Let us now look at some of the results achieved by this company during the past few years. For the year ended October 31, 1929, the company treated a total of 6,183,682 cubic yards at a cost of 3.46d. per cubic yard, as against 3,860,350 cubic yards in the previous period at a cost of 4.06d. per cubic yard. With an average value of 0.89 lb. per cubic yard, there was recovered 2,469 tons of tin ore, an increase of 1,106 tons as compared with the previous year. This result provided a valuable testimony to the efficiency of the modern machines the company has installed at the property and also to the capable manner in which the dredges have been handled by the staff at the mine. The outcome of the year's operations was a net profit of £167,434, as compared with £69,832 in the previous year, being an increase of no less than

£97,602. This most gratifying result was largely due to the fact that all the four dredges were in commission during the whole period. The shareholders proved exceedingly fortunate for they received dividends for this year totalling 60 per cent., while a sum of £20,728 was carried forward.

During the period ended October 31, 1930, the company had to take into account the effect of restriction, and No. 1 dredge was withdrawn from commission at the end of February, 1930, after four months' work, while Nos. 2, 3 and 4 worked throughout the period and proved efficient machines. The working results showed that 4,854,630 cubic yards were treated at a cost of 4d. per cubic yard, as against 6,183,682 cubic yards at a cost of 3.46d. per cubic yard in the previous year. The decreased yardage was due to the stoppage of No. 1 dredge and the difficult dredging conditions for both Nos. 3 and 4 dredges, which also accounted for the increased cost per cubic yard. Nevertheless, in spite of the difficulties encountered, the final outcome of the year's work disclosed a profit of £75,796 which was less than half that earned in the previous period, the decrease being due to the reduced output obtained and lower prices realised for tin ore. In comparison with many other undertakings, this profit was very substantial, and the directors were able to pay dividends for the year totalling the handsome figure of 30 per cent. During this year the material for the new 15 cubic foot bucket dredge, to which we have already referred, was arriving on the property, and the management was pinning its faith on the efficiency of this new factor in the situation.

The policy of the company has been thoroughly justified by the event, for, as they foresaw, under the laws of supply and demand, the uneconomic producers have had more or less to cease work until there is a trade revival, but so far as the Petaling Tin Mine is concerned it is weathering the storm of economic stress most successfully. Turning to the figures for the year to the end of October, 1931, we find that the working results showed that 4,054,060 cubic yards were treated at a cost of 3.09d. per cubic yard, as against 4,854,630 cubic yards at a cost of 4d. per cubic yard in the preceding year. Naturally, the accounts for this period were bound to show a decreased profit owing to the lower outputs due to the introduction of the international quota scheme and also the further fall in the value of tin, the average price realised being £64 14s. 5d. per ton, as against £86 5s. 7d. per ton in the previous year. The profit was again down by more than half in comparison with that earned in the previous year, but the shareholders still received a good return in the shape of dividends totalling 12½ per cent.

And how well the company is coming through these depressing times is still further shown in the really remarkable results for the year ended October 31, 1932. According to the summary of the report and accounts for this period, the net profit comes out at £50,635, and with the balance brought forward there is a total available surplus of £77,314. The directors are thus able to declare a final dividend of 5½ per cent. which, with the interim dividends of 14½ per cent. already declared, will make the total distribution for the year as much as 20 per cent. The output for 1931-32, under the varying restriction percentages, was 1,190 tons.

It is well worth noting that the Petaling Tin Mine, as organised to-day, would be the largest individual producer in Malaya but for the terms of the restriction, but as it is, we imagine that both the shareholders and the management are thoroughly satisfied with what has been achieved under very adverse conditions, and as we have previously indicated, the outstanding success of this company demonstrates most emphatically the great value of capacity and low working costs.

The Sumitomo Works

The industry of the Sumitomo Electric Wire & Cable Works, Limited, has its origin in wire manufacturing as a part of the undertakings of the former Sumitomo Copper Works at the time of establishment in April 1897. Since then the copper works began manufacturing insulated wire and cable in 1908 in order to cope with the increasing demands of the market for such products due to the development of electric enterprises in Japan, the result of which was the formation, in August 1911, of the Electric Wire & Cable Works, as an independent establishment, separated from the Sumitomo Copper Works. In the line of manufacturing bare metal wires the Works has, therefore, a long experience of 30 years in that of manufacturing insulated wires it has 19 years' experience. During these periods the Works had added something thereto, in tangible form through steady work in research as well as in untiring effort for the improvement of its manufactured products.

With the expansion of its industry the Works' plant at Ajikawa became incommodious and there was no room left for extension. For this reason, the present site was chosen in 1915 for a new plant, the construction of which was completed in the following year with several improvements added thereto later. The industrial co-operation made in December 1920 with the Western Electric Company, Inc., of America through the Nippon Electric Company, Limited, of Tokyo brought a change in the organization of the works which, with a capital of Y10,000,000, became a joint-stock company known under the new name of the Sumitomo Electirc Wire & Cable Works, Limited, succeeding, in all its industry, to all the rights and interests of its predecessor, the Sumitomo Electric Wire & Cable Works, in addition to the transfer of patent rights and special industrial relationship with the Aluminium Company of America the works has recently acquired a superior technical art of industry, drawing ample supply of excellent materials from the Aluminium Company. In short, the works is completely equipped for manufacturing any kind of electric metal wire and cable as well as various insulated ones.

In June 1931 the capital of the company increased to Y15,000,000 with the establishment of the branch factory at Tsurumachi, Osaka. The branch manufacturing what is called G.P. cablegram wire, under the contract made with the Department of Communications of Japan. The cablegram wire was supplied mostly from abroad but now the product of the company meets all domestic needs.

The Works always makes it a principle that all its products shall be of superior quality as well as reliability. Provided with all the equipment for chemical, electrical and mechanical testings and research, the works concentrates its energies upon careful selections of materials for use, strict examinations of the finished articles and their improvements, thereby winning a reputation for its superior quality, which is now widely acknowledged by the public. The products are as follows: Copper wire/cable, tinned copper wire/cable, flat or rectangular copper wire/cable, trolley wire, brass wire/cable, silicon-bronze wire/cable, phosphor-bronze wire/cable, aluminium wire/cable, steel-core aluminium wire/cable, special bronze wire/cable, bare copper cable or bare stranded copper conductor, braided copper wire/cable, etc., (*a*) Vulcanized rubber insulated wire/cable; vulcanized rubber-insulated wire/cable as per Japanese Government Electrical Code Class III and IV, rubber wire/cable for Communication or Navy use, high-tension or special high-tension rubber-insulated wire/cable, vulcanized rubber-insulated and lead-covered wire/cable, vulcanized rubber-insulated and armored cable, etc. (*b*) Flexible cord: flexible cords as per Japanese Government Electric Code Class I and II, twin flexible workshop cord as per Japanese Government Electric Code Class III A/B, flexible cord Class IV, flexible heater cord, cargo cord, flexible cord for exports, etc. (*c*) Paper-insulated and lead-covered cable: paper-insulated and lead-covered (galvanized iron wire armored or not armored) cable for electric light or power, paper-insulated and lead covered cable for telegraph or telephone, etc. (*d*) Cotton-insulated wire: cotton insulated wire Class I and II, cotton braided binding wire, etc. (*e*) Cotton-covered wire and others: Cotton or silk covered copper wire, enamel wire, paraffin wire, asbestos-covered wire, etc. (*f*) Cambric cable. (*g*) Cablegram wire. Sundry accessories: Jointing copper sleeves, joint boxes, jointing lead sleeves, etc. and blue vitriol.

The Board of Directors are, Mr. Ogura Masatsune, president and director; Mr Akiyama Takesaburo, managing director; Messrs. Washio Kageji, Kawata Jun, Shida Fumio, Yamamoto Kiyoshi, J. E. Fullam, Ohhata Genichiro and Yajima Tomozo, directors; Messrs. Matsumo Junkichi, Ohhira Kensaku, and Imamura Sachio, auditors, and Mr. Kobata Tadayoshi, manager.—*The Japan Advertiser.*

The Hai Ho Palliative Scheme*

By C. Y. KAO, Chief Engineer and J. CHANG, Engineer-in-Charge of Designs, Hai Ho Improvement Commission

SINCE 1927, heavy silting had occurred in the Hai Ho, the only waterway for deep draft steamers in North China, rendering ordinary navigation impracticable. This deplorable state of the Hai Ho was caused by the deposit of silt carried down by the Yung Ting Ho, a tributary of the Hai Ho. The harbor of Tientsin was in danger of being abandoned as a port of world importance. Dredging operations in the river had been proved futile. They were far from being efficient to cope with the inrush of silt. The menacing effect of the Yung Ting Ho could be solved only by providing it with an adequate outlet in order to divert its silt-laden water from the Hai Ho. For the purpose of remedying the navigability of the Hai Ho, the Hai Ho Improvement Commission proposed and adopted a palliative scheme consisting of the following six principles:

(1) To strengthen the Pei Yun Ho dykes, wherever necessary, so as to prevent any possible dyke-breaks in order that the Hai Ho may get as much clear water-supply from the Pei Yun Ho as possible, and the country adjacent to the river may be saved from annual inundations.

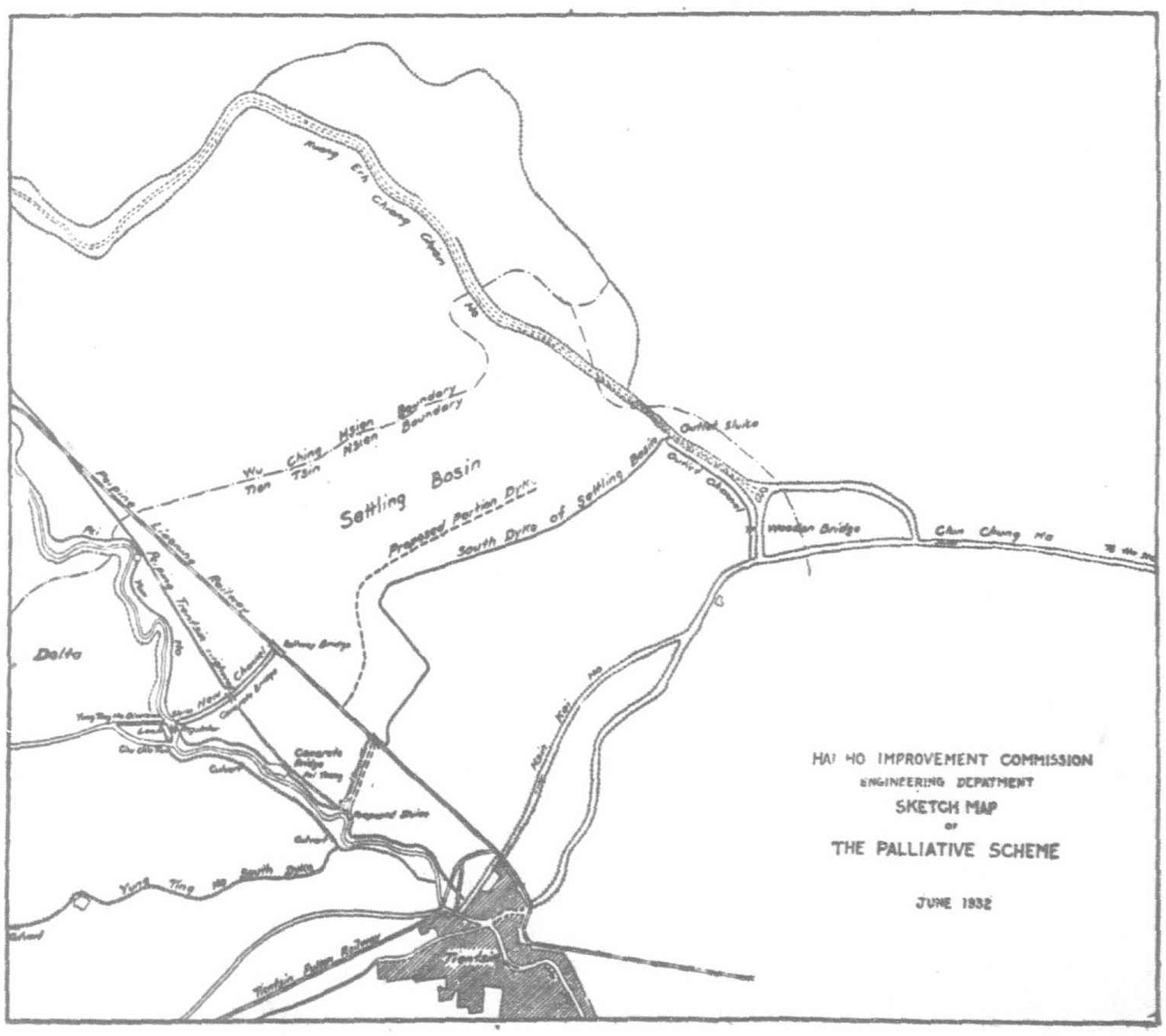
(2) To raise the existing dykes around the Yung Ting Ho Delta to a suitable elevation and to especially raise and strengthen the south dyke of the delta to such an extent that no breach may take place which may endanger the safety of Tientsin.

(3) To provide a new escape channel for the Yung Ting Ho and the Pei Yun Ho freshets, from a point north of Pei Tsang on the Pei Yun Ho in an easterly direction, with a suitable capacity, for diverting a part of the freshets, from coming directly down into the Hai Ho, by means of regulating works at the intake. The diverted portion of the freshets will be carried by the escape channel and will discharge into the Ching Chung Ho and thence to the sea, but as much as possible may be allowed to discharge into the Hai Ho by way of the Hsin Kai Ho.

(4) To construct a sluice of sufficient capacity on the Pei Yun Ho, at a suitable point below the place where the new escape channel commences. The sluice is to be so designed that any possible silting above will not affect its operation. A boat-lock of adequate size for accommodating native craft will be provided adjacent to the proposed sluice.

(5) To make use of a suitable area in the French Marsh (Ta Ho Tien), to be determined, as large as possible, as settling basin for the silt carried down by the new channel, so that the low, marshy lands in that district may be converted into high, cultivable lands. The above area is to be surrounded by a dyke of sufficient height and strength to prevent the spreading of the water which may endanger the neighboring districts.

(6) To place all the regulating works, including those at Suchuang, Tu Men Lou, Hsin Kai Ho and Machang, under one central control so as to secure proper co-ordination in their operation.



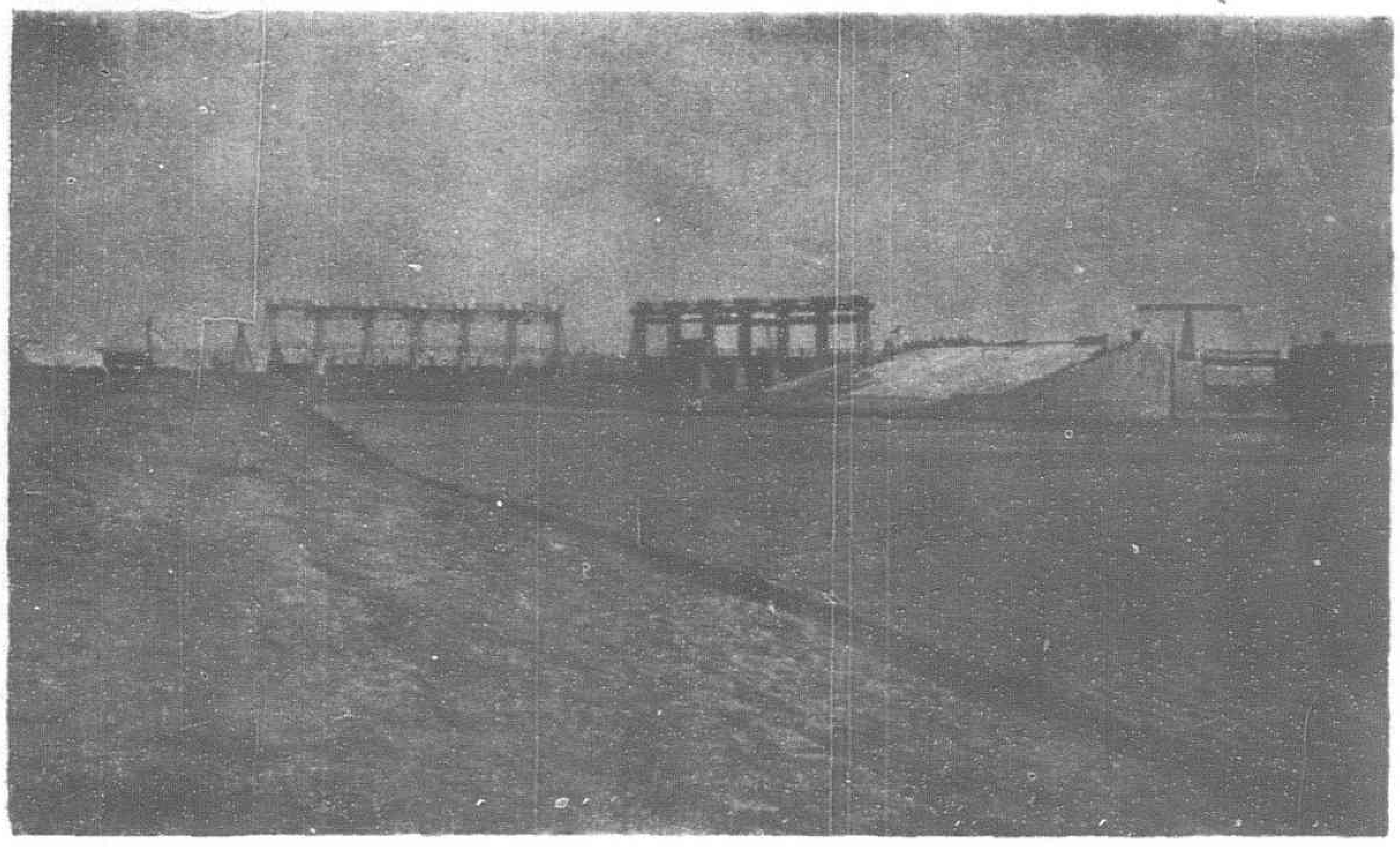
Before the various engineering works were designed, discharge capacities and maximum water levels were ascertained. The maximum discharge of the Yung Ting Ho above San Chia Tien is 5,000 to 6,000 cubic meters per second, which, when reaching Shuang Ying, will be greatly reduced by flow over diversion weirs and by seepage along the river channel. In 1912, the maximum flood level at Shung Ying was 23.3 meters T.D,† its corresponding discharge being 2,733 cubic meters per second. Any output exceeding this amount will cause dykebreaks in the upper course of the Yung Ting Ho. Hence the inflow into the delta at Shuang Ying will seldom exceed 2,733 cubic meters per second irrespective of the controlling effect of the detention dam proposed to be built at Kuan Ting. The outflow from the delta will meet the Pei Yun Ho flow at Chu Chia Tien. A part of the confluence of these two rivers will flow into the Hai Ho through the regulator, and another part will flow into the settling basin through the sluice and the leading channel, and thence to the sea through the outlet sluice, the outlet channel and the Ching Chung Ho. When the Yung Ting Ho is heavily silt-laden, the regulator should be closed in order to prevent silting the Hai Ho. Based upon the foregoing conditions of flow, it was computed that the maximum water level in the delta will be 7.7 meters T.D. and that in the settling basin 4.3 meters T.D.

Design and Construction of Engineering Works

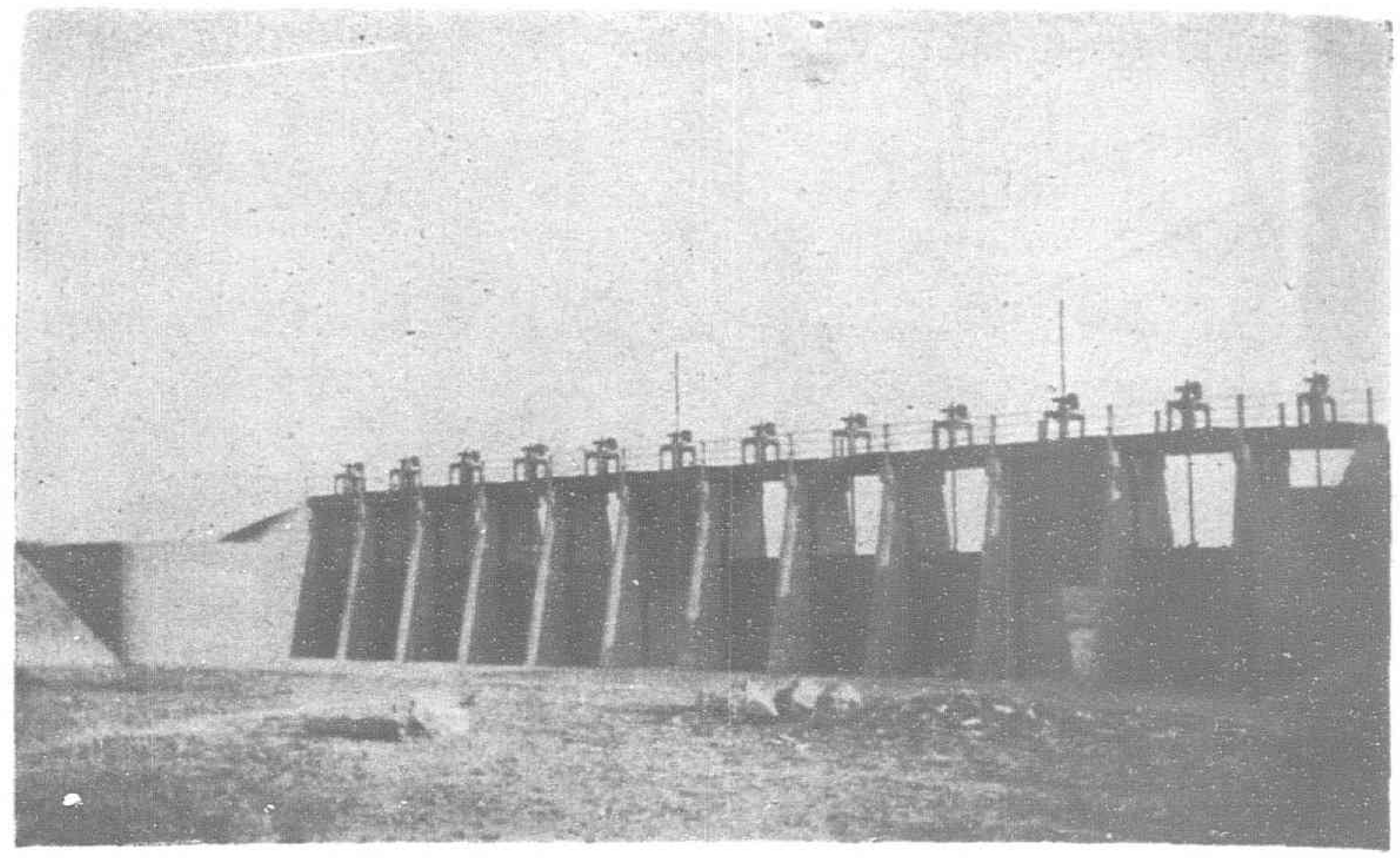
The sluice at the inlet of the new leading channel is situated on the eastern side of the Pei Yun Ho near Chu Chia Tien. Its purpose is to divert the silt-laden flood water of the Yung Ting Ho into the settling basin. The total width of the sluice is 44 meters with six clear openings of six meters each and five piers each 1.6 meters wide in between. Stony gates are used. Each gate, six meters high, is built up of six 18 inch I-beams supporting $\frac{3}{8}$-in. skin plates. A reinforced concrete breast-wall, 1.5 meters high, spans each opening with its bottom elevation a little below the top of the gate. Each gate weighs approximately 10 tons, and is operated by two sets of hand power hoists placed on top of a reinforced concrete trestle. Roller trains and counter weights are used to lessen the duty of the hoists. Plain concrete of 1 : 3 : 6 proportion is used for the floor and the same mixture with 15 per cent rubble is used for the abutments, wing walls and piers. A 4 meter slab and

*Journal of the Association of Chinese and American Engineers.

† T. D. Taku Datum.



General view of Sluice, Regulator and Lock



Outlet Sluice

beam bridge of reinforced concrete construction is supported on top of the piers and abutments to facilitate local communication. Underneath the floor, three rows of Wakefield sheet-piling 7 meters long driven in across the foundation to increase the length of percolation. The foundation piles are 10 meters long with diameter at the butt end not less than 2.5 decimeters. Riprap placed in wire cages is extended above and below the floor to a considerable length. The adjacent banks of the sluice upstream and downstream are protected with stone pitching. The foundation work which consists of 1914 piles and 7,000 cubic meters of earthwork was started on December 11, 1930, and completed on March 31, 1931. The construction of the superstructure of the sluice was started on March 23, 1931, and completed on September 14, 1931.

The purpose of the regulator across the Pei Yun Ho is to prevent the silty water of the Yung Ting Ho from flowing down into the Hai Ho. Normally it maintains a free passage of flow when the river water is clear. There are also six clear openings within a space of 44 meters ; the width of each opening is 5.8 meters. The construction and general arrangement of the regulator resemble those of the sluice in most respects, except that two gates are used for each opening instead of one. The upper gate being of Stony type is 4.7 meters high and is built up of five 15 inch I-beams. The lower gate with cast iron rollers attached to the back is 1.2 meters high and is built up of three 15 inch I-beams. All the skin plates used are ⅜-inch thick. Separate sets of hoisting machinery are used for the upper and lower gates so that they can be operated independently. There are 1,064 round piles in the foundation. The work was started on October 1, 1931, and its concrete construction was carried on through the winter during which special means were provided to maintain a moderate temperature on the working site. The entire work was completed on May 15, 1932.

The navigation lock is constructed on the western side of the Pei Yun Ho for the passing of boats when the regulator is closed. Wooden miter gates operated by worm gear capstans are installed at the upper and lower bays of the lock chamber. To open the gate, the water levels on both sides of the gate are equalized through the side culverts in the abutments, which are controlled by butterfly valves. The length of the chamber is 80 meters and its width at the bottom is 11 meters. The banks are of 2 to 1 slope with bottom elevation at 1.3 meters T.D. and top elevation 8.5 meters T.D. Each bay is 8 meters wide and a steel lifting bridge is constructed on the lower bay for the convenience of local communications. The maximum water level may reach 7.5 meters T.D. and the normal water level about four meters. T. D. giving a depth of water about two meters for navigation. Concrete used for the abutments and wing walls is 1 : 3 : 6 proportion with 20 per cent rubble. There are 1,250 round piles in the foundation, which are 10 meters long with diameter at butt end not less than three decimeters. In the summer of 1932, a considerable amount of silt was deposited in front of the upper gate making its manipulation very difficult. Necessity for the frequent passing of boats called for the replacement of the wooden miter gates by steel gates of the vertical lift type. The new gates are made of five 15 inch I-beams supporting ¼-inch skin plates with cast iron rollers attached to the back at two sides. They are stayed by shear-legs and lifted by winches. Piling work was started in June and completed in September, 1930. The construction of the lock was started on February 19, 1931, and completed on August 24, 1931. The replacement of gates starting from July 18, 1932, took four weeks' time.

The purpose of the new leading channel is solely the diversion of the silty flood water of the Yung Ting Ho into the settling basin. The channel occupies a strip of land 4.4 kilometers long and 200 meters wide. The average depth of excavation is 0.6 meter and the excavated material is just enough for building the two dykes. The top elevation of the dykes at the downstream end of the sluice is 7.7 meters T.D. and slopes down with 1/2,000 grade to meet the embankment of Peiping-Liaoning Railway, east of which the flood water is allowed to spread freely over the low-lying land. At the rising stage of the Yung Ting Ho freshet, when the discharge is somewhere between 50 and 200 cubic meters per second, the river carries the highest percentage of silt. At this stage, the regulator should be closed and the sluice opened so as to divert all the silty water through the new leading channel into the settling basin. The maximum capacity of the Pei Yung Ho below Chu Chia Tien is estimated to be 400 cubic meters per second and that of the new leading channel is calculated to be over 700 cubic meters per second. The earthwork, totalling 355,000 cubic meters, was let in two separate contracts. Construction was started on April 3, 1931 and completed on June 3, 1931.

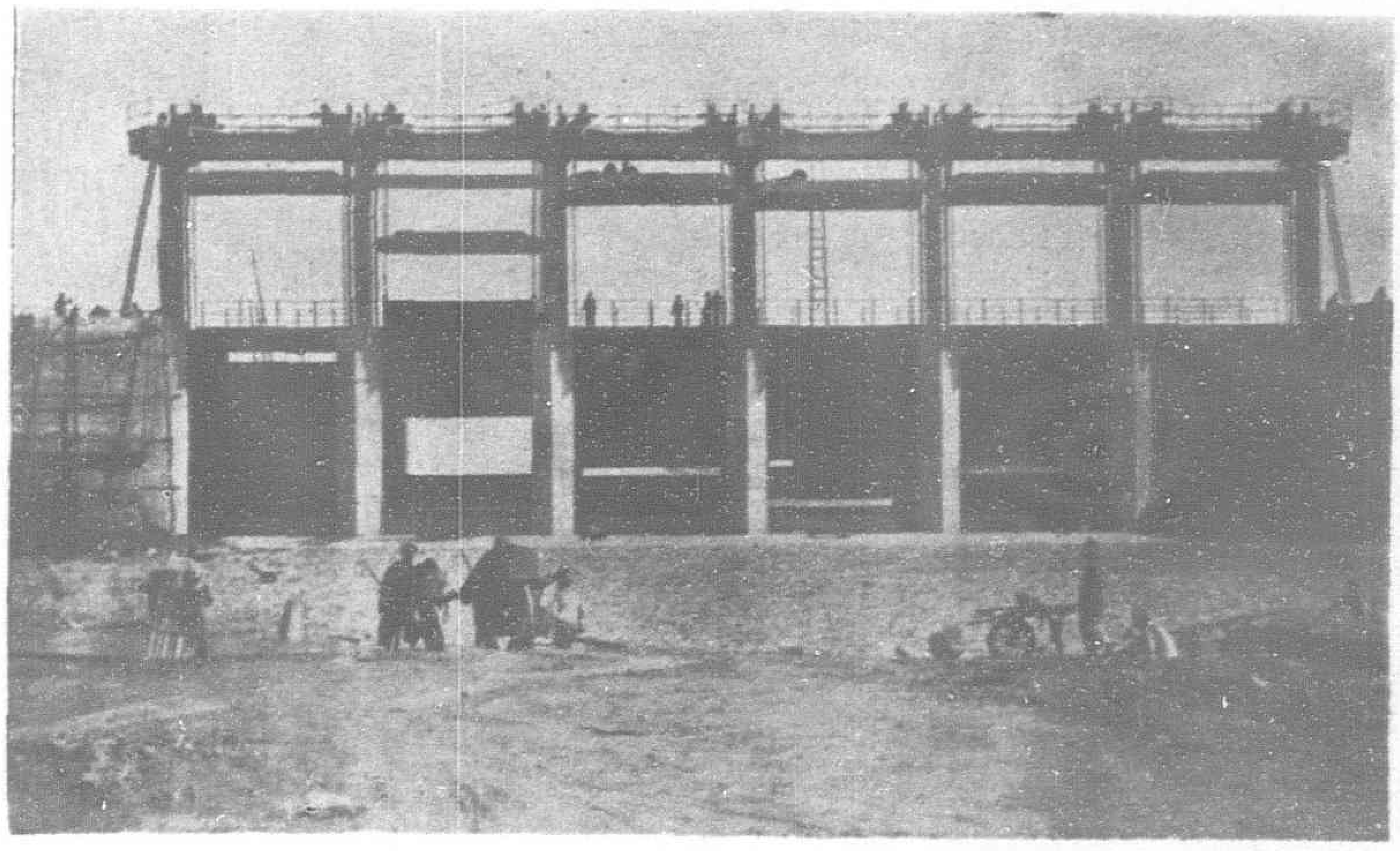
Strengthening of the Pei Yun Ho east dyke, from Tien Chi Miao to Yang Tsun, involves 280,000 cubic meters of earthwork with a total length of 29.5 kilometers. The portion of the west dyke strengthened, from Tang Chia Wan to Chu Chia Tien, is 7.7 kilometers long and involves 266,000 cubic meters of earthwork. From the previous flood records the highest water level is 7.28 meters T.D. at Peitsang, 7.5 meters T.D. at Chu Chia Tien and 7.98 meters T.D. in the delta. It is planned that in the future not only a portion of the flood will be discharged below the regulator into the Hai Ho, but also that another portion will be diverted through the new leading channel into the settling basin. From computations, the maximum water level in the delta is 7.7 meters T.D. and that at Yang Tsun, 8.1 meters T.D. Even in case the Yung Ting Ho and the Pei Yun Ho have their peak flows at the same time, the water level at Yang Tsun will not be farther raised by more than one centimeter. Thus the top elevation of the dykes is raised to 9.0 meters T.D. throughout and the width of the top is made six meters with 3 to 1 slope on the river side and 2 to 1 slope on the land side. The earthwork for the east dyke was divided into three contracts. Construction was started on April 24, 1931 and completed on July 10, 1931. The work for the west dyke was started on October 2, 1931 and completed on December 19, 1931. At two places on the west dyke, Tang Chia Wan and Tao Hua Tze, Armco corrugated pipe culverts are installed in place of the old wooden bridges for effecting better drainage. Three pipes are installed at Tang Chia Wan and two at Tao Hua Tze. Each pipe is five feet in diameter and 14 meters long. Both ends of the pipes are imbedded into the concrete abutments of 1 : 3 : 6 proportion with 15 per cent rubble. A Calco slide head gate is installed at the end of each pipe on the river side. Riprap protection of half meter thickness is extended beyond each side of the abutments. The foundation for the pipes and abutments is thoroughly compacted with 1 : 3 lime-earth mixture. Work was started on May 26, 1932 and completed on August 4, 1932.

The portion of the south dyke of Yung Ting Ho to be strengthened starts from Tang Chia Wan and ends at Erh Shih Erh Hou Fang Tze. It has a total length of 16.2 kilometers and involves 174,000 cubic meters of earthwork. As stated in the preceding paragraph, the maximum water level in the delta will not exceed 7.7 meters T.D., thus the top elevation of the dyke is raised to 9.0 meters T.D. from Tang Chia Wan to 11 meters T.D. at Erh Shih Erh Hou Fang Tze. The top width is six meters and the side slopes are 3 to 1 and 2 to 1 respectively, the same as for the Pei Yun Ho dykes. Work was started on April 4, 1931 and completed on September 30, 1931. To effect better drainage of the delta near Erh Shih Erh Hou Fang Tze, four 60 inch Armco corrugated pipe culverts are built on the dyke. The pipes are 12 meters long and Calco slide head gates are installed at the upstream end. Their construction features are similar to those at Tang Chia Wan and Tao Hua Tze. The work was started on July 5, 1932 and completed on September 22, 1932.

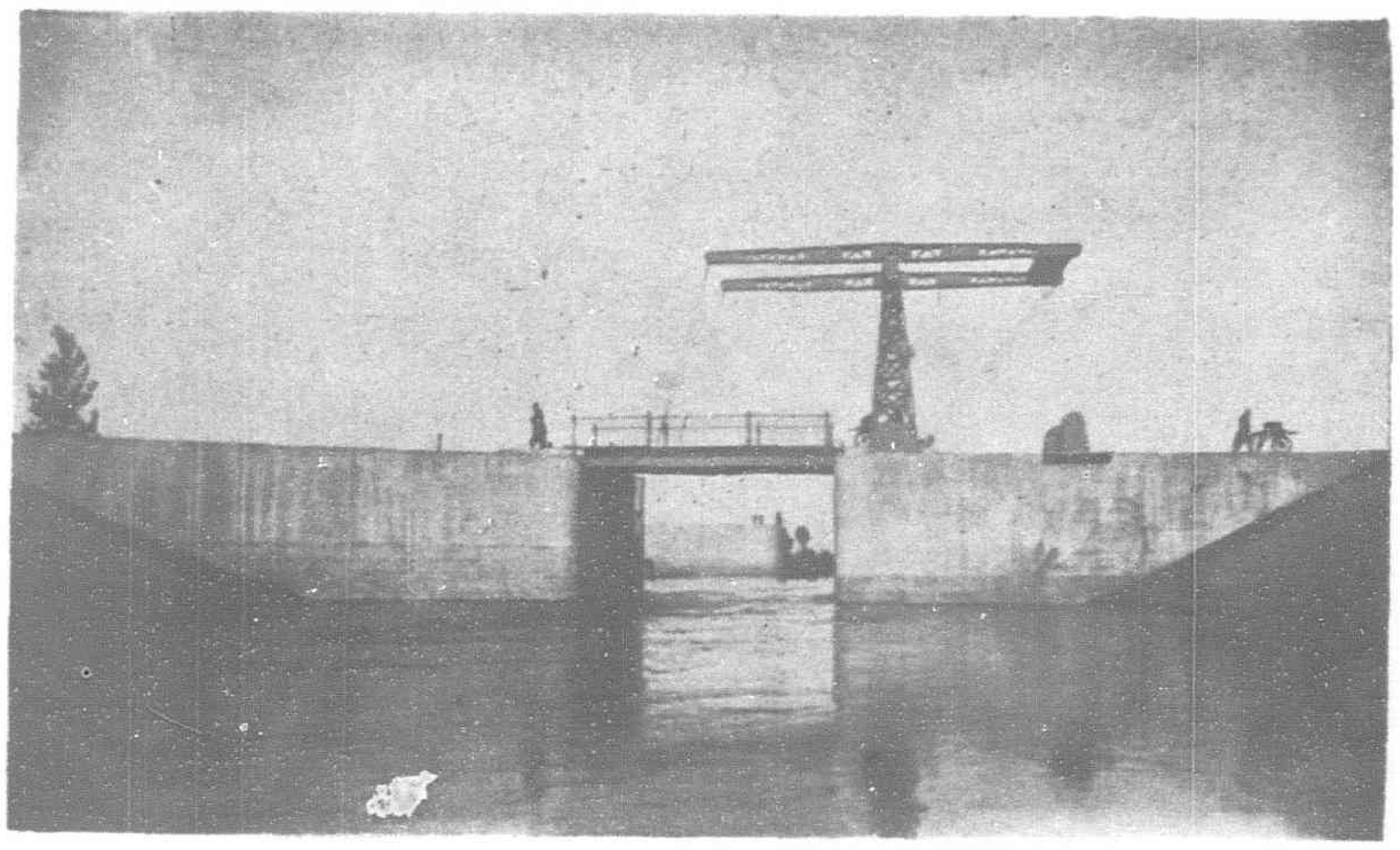
The Yung Ting Ho diversion channel is 1.7 kilometers long with an average depth of excavation of about 3.3 meters. No dykes are built to restrain the passage of flood which is allowed to spread within the delta. Four earth check dams are built in the old course of the Yung Ting Ho, utilizing the excavated material as much as possible. At the junction of the Pei Yung Ho with the old course of the Yung Ting Ho a 36 inch concrete pipe culvert is built for the purpose of drainage. The total amount of earthwork is 220,000 cubic meters. The work was started on September 23, 1931 and completed on April 25, 1932. In October, 1932, a stone groin was constructed along the west dyke of the Pei Yun Ho above its junction with the old course of the Yung Ting Ho to protect the newly-built dyke from erosion.

The crossing of the Peiping-Tientsin highway over the new leading channel necessitated the construction of a reinforced concrete trestle bridge. The bridge is 170.7 meters long, 6.1 meters wide, and is divided into 28 spans. The slab on each span is 15 inches thick and is supported at both ends by 12 by 18 inch cross beams, which in turn are supported by 12 inch square columns arranged four in a row. Underneath each column is a 16 inch octagonal reinforced concrete pile 40 feet long. A layer of 3 inch concrete pavement is placed on top of the slab with a thin coat of asphalt in between. Cast iron pipes are used for railings. The work was started on July 4, 1931 and completed on December 17, 1931.

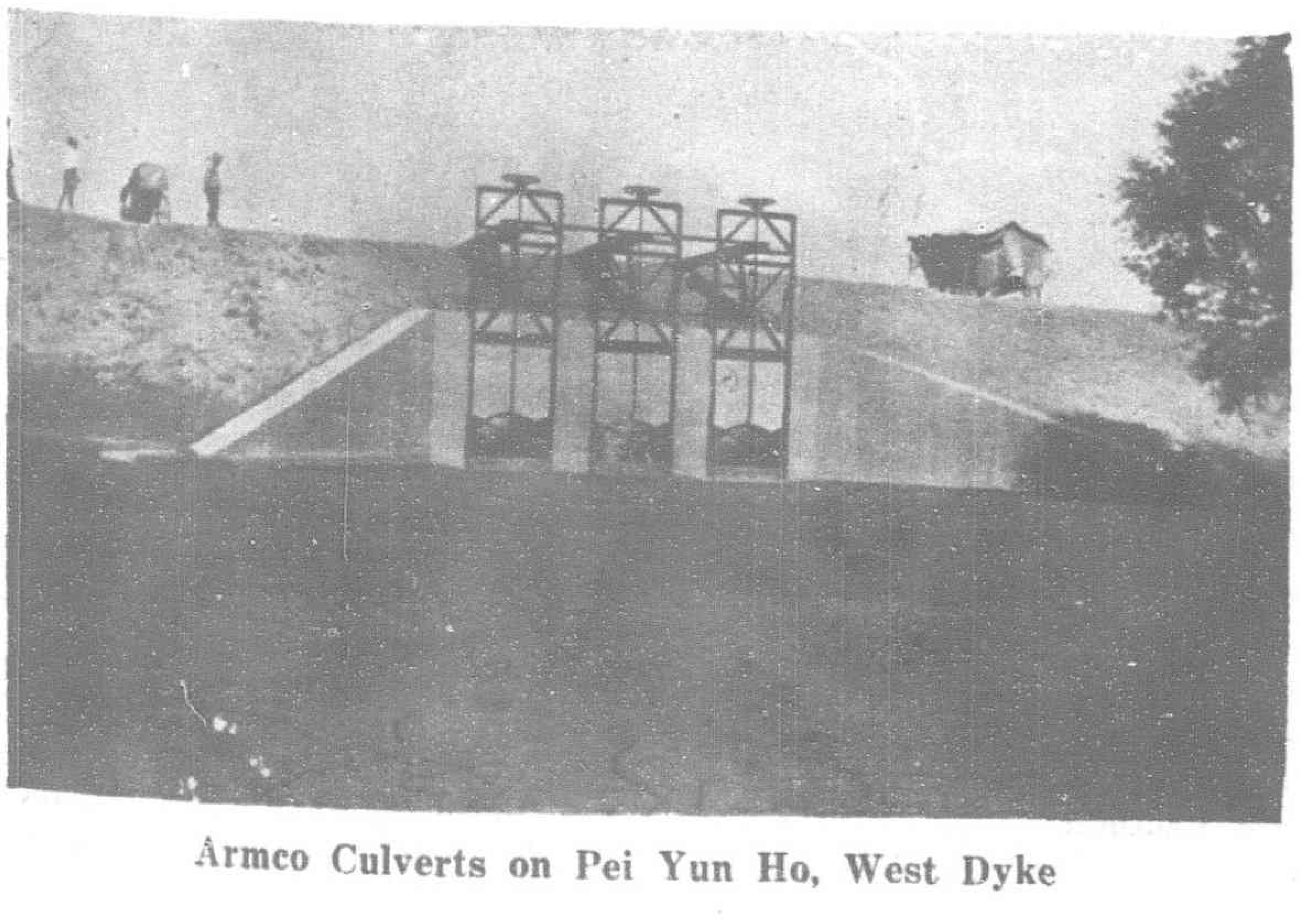
A reinforced concrete girder bridge is built at the crossing of Peiping-Liaoning Railway over the new leading channel. This bridge consisting of 20 spans of 30 feet each was designed and constructed under the supervision of Peiping-Liaoning Railway. The work was completed last summer.



Regulator



Lock



Armco Culverts on Pei Yun Ho, West Dyke

The south dyke of the settling basin starts from bridge No. 25 of Peiping-Liaoning Railway and ends at the outlet sluice near Lu Hsin Ho. The total length is 18.7 kilometers. The top elevation of the dyke is six meters T.D. throughout and its top width is six meters with 3 to 1 slope on the water side and 2 to 1 on the land side. Earthwork was divided into three contracts making a total of 882,000 cubic meters. The work was started on October 1, 1931 and completed on December 15, 1931.

Surrounding dykes are built around 18 villages under the jurisdiction of the Tien Tsin Hsien which are scattered in the settling basin for the purpose of protection during the period of flood diversion. There are altogether 14 dykes, several of which inclose two or more villages. The top width of the dykes is four meters and their top elevation is six meters T.D. The inner side slopes are 2 to 1 and the outer side slopes 3 to 1. The total amount of earthwork is 760,000 cubic meters. Construction was started on March 17, 1932 and completed on May 12, 1932. On each of the dykes, sufficient numbers of intake culverts and drainage culverts are constructed for the convenience of the villagers. All culverts are built of 12 inch vitrified pipes of standard dimensions. Brick headwalls with wooden slide gates are placed on the inner ends of the culverts. Work for construction of culverts was started on June 10, 1932 and completed on July 9, 1932.

The water in the settling basin is drained through the outlet sluice into the outlet channel, farther into the Ching Chung Ho, thence flowing into the sea. The total width of the structure is 36.4 meters with 12 clear openings of 2.6 meters each. The maximum water level on the upstream side of the outlet sluice is assumed to be five meters T.D. and its maximum discharge capacity is 200 cubic meters per second. The outlet sluice consists of 12 wooden gates three meters wide by 2.9 meters high worked between steel trestle bents encased in 1 : 2 : 4 concrete, and operated by bevel-gear hoists placed on a wooden platform. Concrete for the abutments and wingwalls is of 1 : 3 : 6 proportion with 15 per cent rubble. The floor, 0.6 meter thick, is built of 1 : 3 : 6 concrete. The work was started on October 6, 1931 and completed on January 14, 1932.

The outlet channel, which starts from the downstream end of the outlet sluice down to the Ching Chung Ho, has a total length of 6.2 kilometers. The bottom width of the channel is 34 meters and the average distance between two dykes is 100 meters. Its east dyke is formed by reconstructing the existing west dyke of the Kuang Erh Chiang Chien Ho while the west dyke is entirely of new construction. The material for embankment is all taken from the excavation of the channel. The top elevation of the dykes is 5.5 meters T.D. and inner and outer side slopes are 3 : 1 and 2 : 1

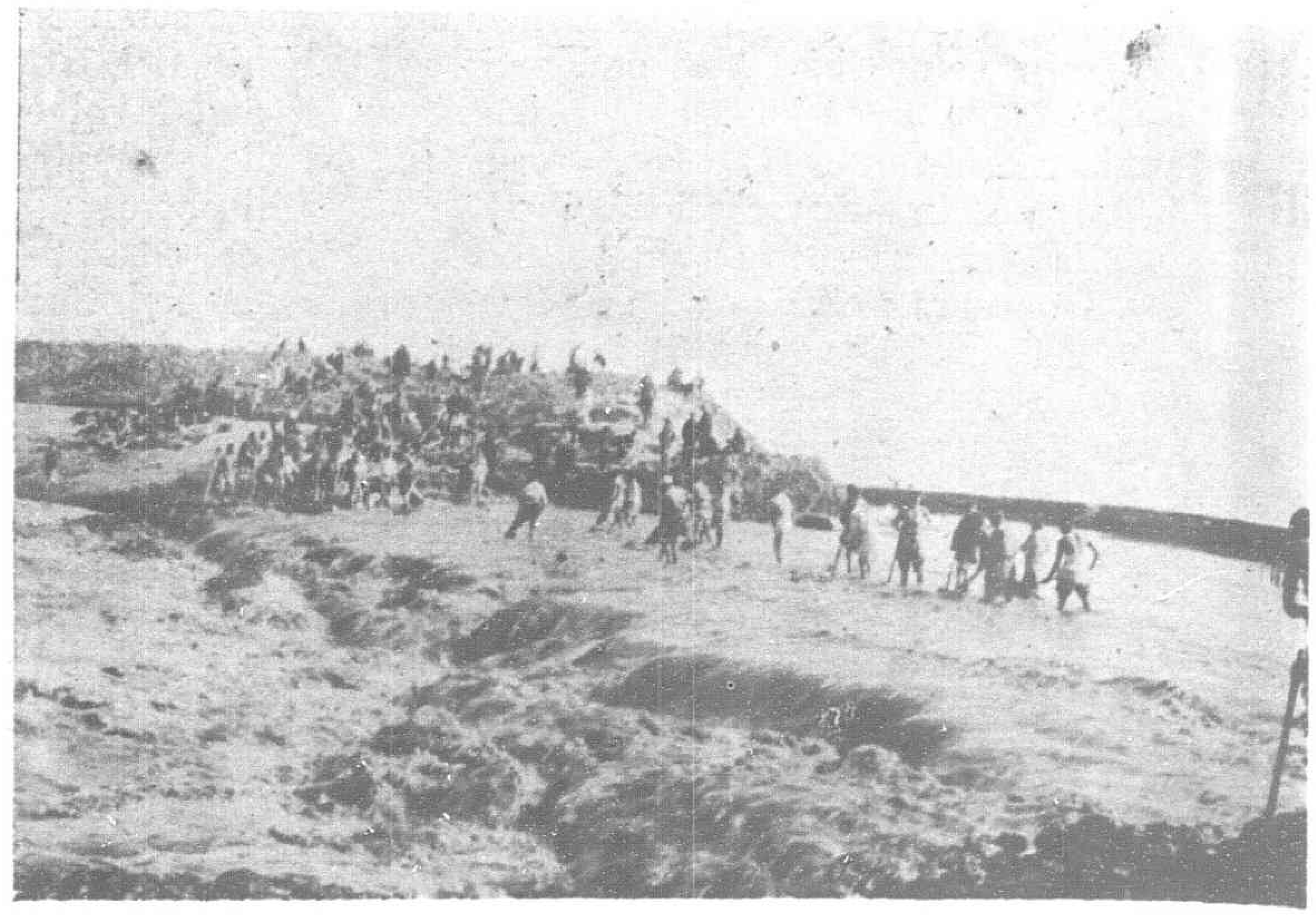
and 2 : 1 respectively. The bottom elevation of the channel is 1.7 meters T.D. at the outlet sluice and the river bed slopes down with 1/6,200 grade to the Ching Chung Ho where its elevation is 0.7 meters T.D. The maximum discharge capacity of the channel is 200 cubic meters per second. The work, totalling 310,000 cubic meters of excavation, was started on October 1, 1931 and completed on May 2, 1932.

A wooden trestle bridge is constructed over the Outlet Channel near Liu Kwei Chwang to facilitate local communication. It is 15½ feet wide and 312 feet long with 24 spans of 13 feet each. The trestle bents are formed by driving in piles of 25 feet and 31 feet length having 12 inches diameter at the butt end, to their proper elevations. The piles are arranged four in a row spliced with 3 by 10 inch bracers. The floor is built up of 4 inch planks fastened to five 6 by 12 inch stringers which are supported by 8 by 10 inch cross beams at the ends. The cross beams in turn rest upon tops of the wooden piles. Wooden posts are used for railings. The work was started on March 7, 1932 and completed on April 21, 1932.

All the composite works of the palliative scheme were completed by May, 1932, enabling the Yung Ting Ho freshet to be diverted into the settling basin this summer. During the whole season, the silt-laden flood waters of the Yung Ting Ho were diverted three times as follows :

		Volume of Flow	*Silt Content*
1.	From Aug. 1 to Sept. 2	504,210,000m³	12,931,000m³
2.	From Sept. 10 to Sept. 13	19,680,000	198,000
3.	From Sept. 15 to Sept. 20	23,600,000	135,000
	Total		13,264,000m³

Had those more than thirteen million cubic meters of silt been deposited into the Hai Ho, it would have been an unparalleled, tremendous disaster to the harbor of Tientsin. Because of the successful operation of the palliative scheme, the condition of the Hai Ho has shown remarkable improvement.



Opening Yung Ting Ho Diversion Channel

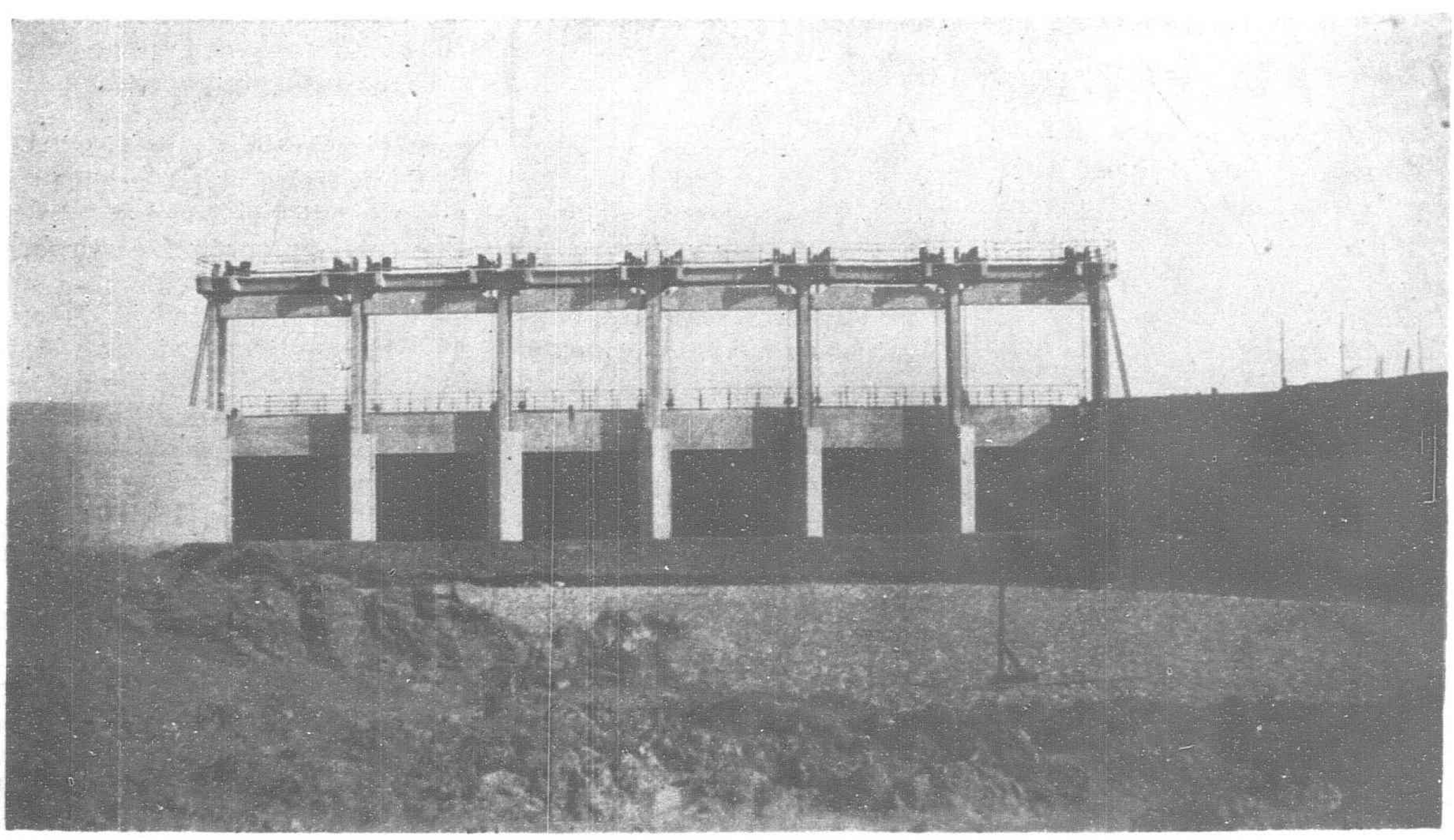
The palliative scheme is to avert or reduce the future silting of the Hai Ho. However, the navigability of the Hai Ho can be further improved by bringing the clear water from the settling basin back into the Hai Ho, thus scouring its bed and increasing its capacity. In order to attain the foregoing advantageous effect, the Hai Ho Improvement Commission proposed to carry out an additional project which consists of the following three principles :

(1) An escape channel shall be excavated starting from the south-western corner of the settling basin and discharging into the Pei Yun Ho near Nan Tsang. A part of the clear water in the settling basin (after the silt has been deposited) can be returned to the Hai Ho through the escape channel, the discharge capacity of which will be 120 cubic meters per second.

(2) A partition dyke shall be built in the southern section of the settling basin extending easterly from Peiping-Liaoning Railway embankment, in order to prevent the silty water from flowing back directly into the Pei Yun Ho before its silt is deposited.

(3) A sluice shall be built at the confluence of the escape channel with the Pei Yun Ho for regulating the flow. A highway bridge shall be appended to the sluice so as to accommodate the traffic on the Peiping-Tientsin highway.

The various works composing the additional project are in the process of construction undertaken by the Hai Ho Improvement Commission.



Sluice

Gold Prospecting in Pahang for Unemployed

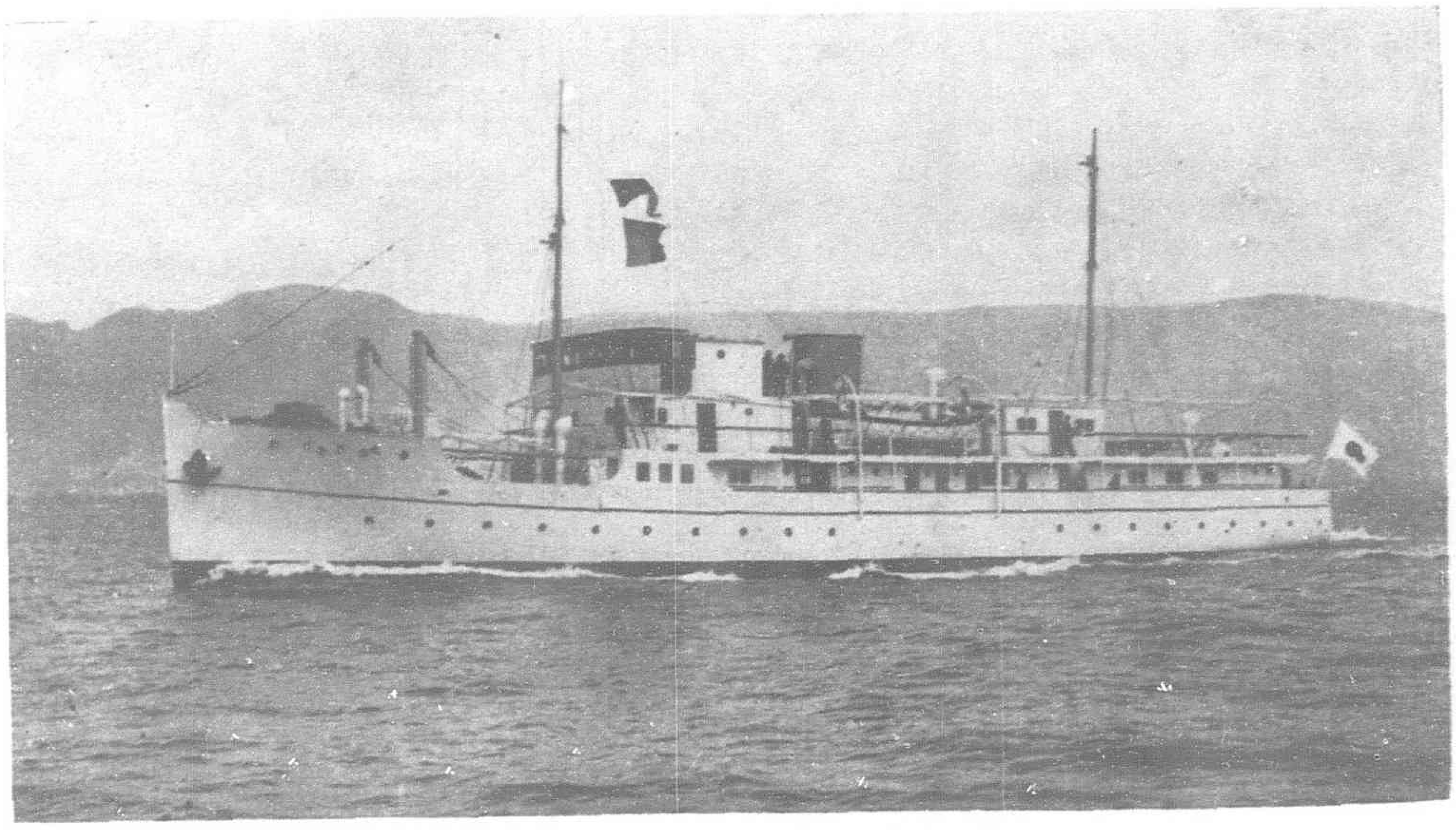
The sudden development in gold prospecting in the State of Pahang, due in part to the widespread closing down of tin mining operations, was the subject of discussion in the recent meetings of the F.M.S. Federal Council. In answer to questions by Mr. San Ah Wing, it was stated officially that individual licences for gold mining and fossicking are issued in the State of Pahang. Certain areas were opened in 1929, and the Mukim of Ulu Dong, in the District of Raub, was opened from June 17 last. Most of the known gold-bearing areas, excluding river beds are covered by prospecting licences and permits. In the river systems 269 Dulang washers are at work, drawn largely from the unemployed mining population of the State, and the Government is encouraging the industry.

In the course of a speech Mr. San Ah Wing emphasized the importance of issuing individual licences on a large scale. The throwing open of State land for such a purpose, he said, not only afforded opportunity for the absorption of many of the unemployed, but might be the means of discovering untold wealth. Vast stretches of the country had not been developed or penetrated, and the high price of gold provided an incentive to individual miners to work and prospect.

Colonel Cecil Rae advocated the issue of something in the nature of the Australian "miners' right" to Pahang.—*Mining Journal*

New Japanese Motorships are being Constructed for Local Service

By Y. TAJI, M.I.N.A.,M.I.Mar.E.



The m.s. "Okesa Maru" on Trial Run

THE wave of the world-wide industrial depression has blighted again the recent stimulation in Japanese shipbuilding, which has now completely vanished. The needs of the people together with the strenuous effort of the shipbuilders and owners forced the Government to legislate for the encouragement of new construction after scrapping old tonnage under the subsidy, but this has not yet given any effective results. Optimists consider, however, that this measure will be a morning star before a glorious sunrise.

Anyhow, the endeavor of the shipbuilders has now been concentrated to the vital necessity of a struggle for life and so even the premier shipyards in Japan are eagerly and competitively collecting orders for smaller vessels which are suitable for operation in home waters. Amongst them, the following are typical examples of motorships built for local purposes.

The Motor Passenger Ship "Okesa Maru"

The vessel has been designed and built by the Kobe Dockyard of the Mitsubishi Shipbuilding and Engineering Co., Ltd., for passenger service between Niigata in the north-western side of the main Island of Japan and Sado Island on the Sea of Japan. The distance between them is about 34 miles, but the sea is notorious for its roughness, particularly in winter, whilst the north-western coast of Japan has very few good harbors, being generally lined with cliffs like the Atlantic side of Scotland.

Under such circumstances, it is necessary to have a vessel with minimum rolling qualities, maximum seaworthiness and a superior speed for the transportation of passengers, yet to be operated at the utmost economy in fuel consumption and also with every comfort for passengers. For these things special precautions were necessary in the design of the ship, particularly in the general arrangement and equipment.

The leading particulars and general characteristics are as follows :—

Length over-all	166-ft. 6-in.
Length between perpendiculars	160-ft. 0-in.
Breadth moulded	27-ft. 0-in.
Depth moulded	12-ft. 9-in.
Draught, fully loaded	8-ft. 10-in.
Gross tonnage	488 tons
Dead weight capacity	219 tons
Cargo capacity	7,300 cub. ft.
Trial speed in knots	14.66
Number of passengers :—	
Special class	20
Second class	77
Third class	302
Total	399

MAIN ENGINE.—One set of Mitsubishi airless injection Diesel engine of type RG6.

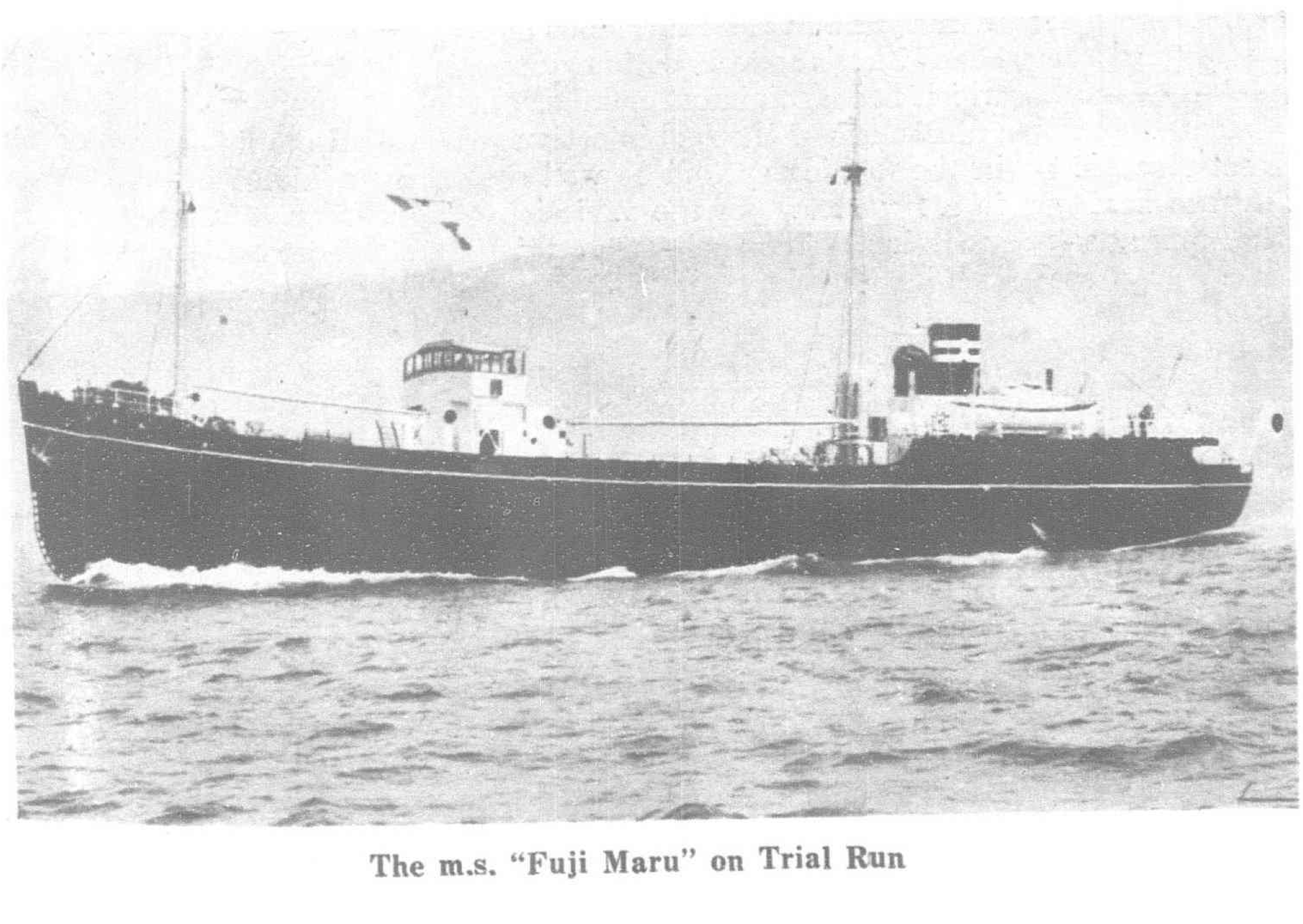
General Arrangement

The vessel has a raked straight stem and a destroyer type stern, the hull being subdivided into five watertight compartments by four transverse bulkheads. The engine room is situated amidships with a large dummy funnel over its top, whilst two masts are arranged fore and aft of the ship.

The forecastle is for the crew's accommodation. The deck house surrounding the engine room casing amidships is utilized for a spacious third class passengers' room on the front, whilst at sides are lavatories for special class passengers, a toilet room, an officers' bath-room, second and third class lavatories, a mail room, and a galley. On the aft part of the upper deck are a spacious second class passengers' room, a third class lavatory and a toilet room.

On the promenade deck, the special class passengers' rooms are provided at the front of engine room casing. Over these rooms are a navigation bridge, a captain's room, and a mate's room. Abaft the engine casing amidships is a social room with a shop attached.

On the fore and aft second deck, adjacent to the machinery room are large third class passengers' compartments, whilst a hand steering gear room is arranged at the aftmost part.

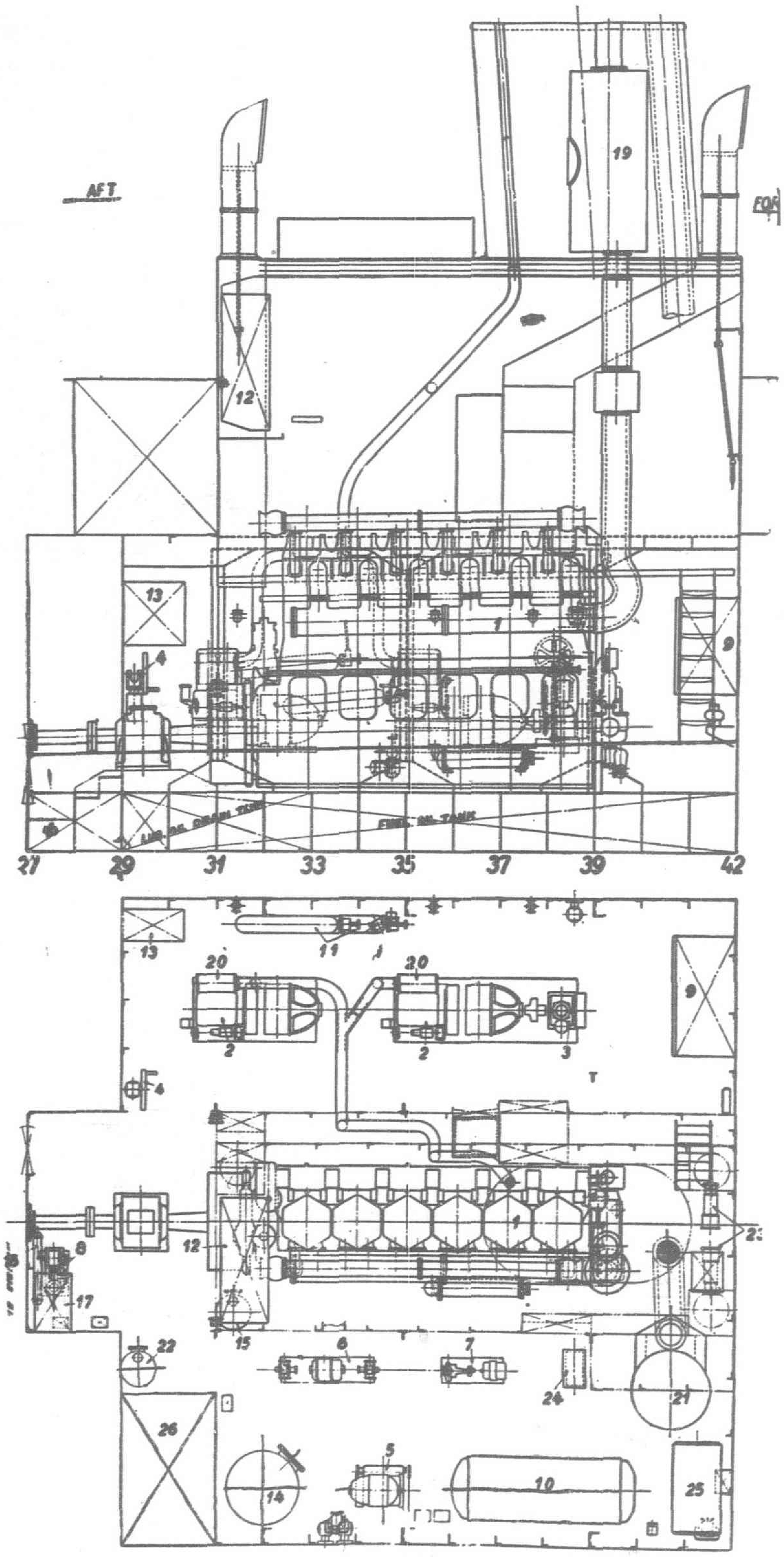


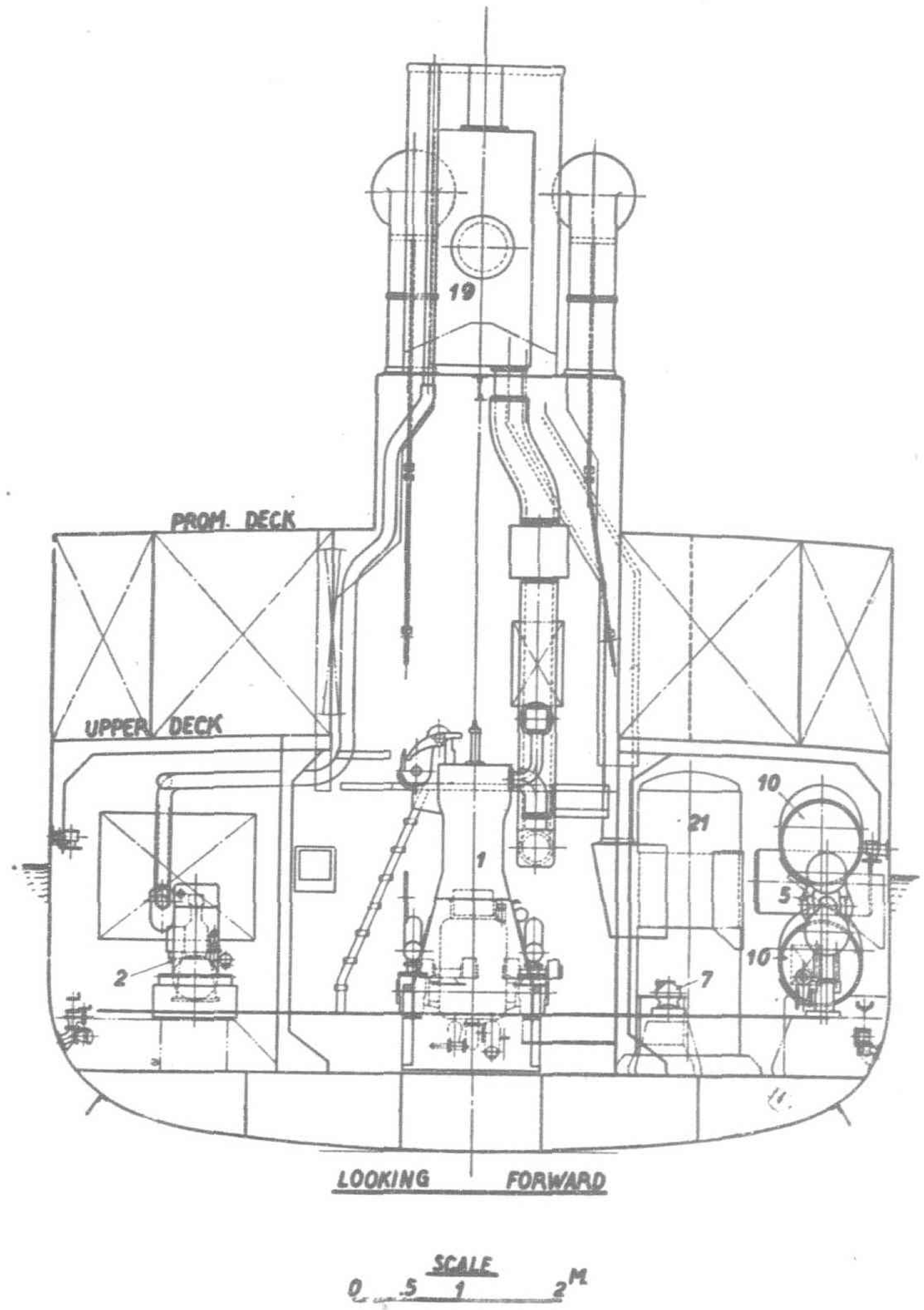
The m.s. "Fuji Maru" on Trial Run

Passengers' Accommodations

Special precautions have been taken for passengers' accommodation and the decoration of various public and private rooms to ensure the complete satisfaction of passengers on this route. The special class rooms on the promenade deck are decorated in ancient style whilst the social room on the same deck in gay, modern style, all being furnished with simplicity and smartness including sofas, tables, and chairs and also radio loud speakers are fitted.

The second class rooms on the fore and aft upper deck are very spacious and are floored with





Engine Room arrangement of m.s. "Okesa Maru." For reading of numerals refer to text

"tatami" (soft Japanese mats) covered with carpets, so that passengers can sit down in their native way to enjoy the beauty of sea scenery. The third class rooms are below the upper deck fore and aft and are also floored with "tatami." The rooms are not only very large, but also well lighted and ventilated.

Steam necessary for the heating of the ship, bath-rooms and galley, is supplied by a Cockran auxiliary boiler in the engine room.

To all rooms, electric lamps, fans and bells are fitted, whilst a 1 kw. search-light is installed on the top of steering house in order to ensure safe navigation at night even in foggy season.

A special wireless receiver being fitted. Passengers can listen in daily broadcasting from five loud speakers.

A British patent balanced and reaction rudder is fitted, which is controlled by a Mitsubishi special hand steering gear in the wheel-house.

As to the cargo facilities, a hatchway is arranged between the forecastle and the central deck house on the upper deck, to which two electric winches and Mannesman's steel booms are attached. The windlass is electrically driven, and also an electric capstan is installed on the poop deck.

Main Engine and Auxiliaries

The main propelling machinery is one set of the Mitsubishi four-cycle, airless injection, trunk piston Diesel engines of type RG6, with six cylinders of 400 mm. in bore and 600 mm. in stroke, developing normally 700 b.h.p. at 240 r.p.m. In the official measured mile trials, a mean overload output of 833 b.h.p. was acquired at 262.5 r.p.m.

The engine, which is illustrated in an accompanying photograph, was designed and constructed by the Mitsubishi Kobe Works, and its easy handling, superior efficiency, robust construction and excellent workmanship have been well recognized by various ships after long actual performance at sea.

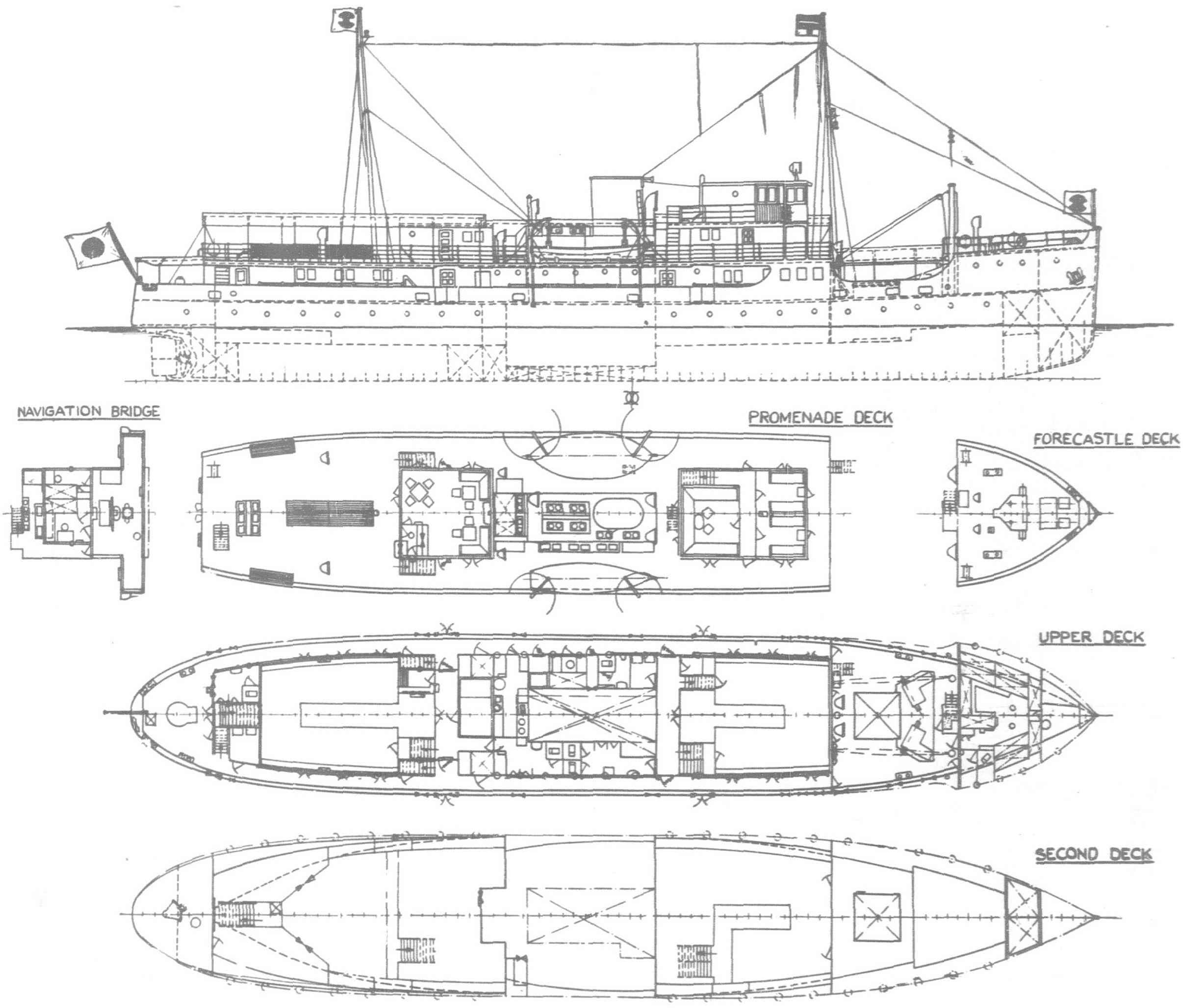
Vicker's solid injection system is adopted for the fuel injection, which has a minimum number of fuel oil pumps and enables easy adjustment of the fuel injection pressure, also annihilating troubles in the fuelling system as well as holding a high thermal efficiency in a large scope of the variation of revolutions and outputs. The variation of the fuel consumption from 10 per cent overload to a half load has been only 169 grams to 172 grams per b.h.p. per hour.

A special design has been applied to this engine for the shape of combustion chambers and the direction of injection, so that the result of combustion has been especially good and exhaust gas utterly smokeless at any load. Another speciality is that the Mitsubishi patent oil-wiping piston rings with two peripheral projections are fitted to the piston packings in order to reduce the lubricating oil consumption.

Further, the manœuvering device is also of the builders' patent design, in which the engine operates automatically ahead or astern by turning a hand wheel clockwise or anti-clockwise, and the state of the engine performance and the variation of the output are indicated on a dial fitted near to the handle, so that the engine can easily be manœuvered by either a skilled or unskilled engineer.

The engine can be started by a starting air pressure of 42 kgs. to 10 kgs. The capacity of the main air reservoirs being 1,800 litres, it is possible to carry on repeated manœuvering of over 37 times.

M. S. "OKESA MARU"
GENERAL ARRANGEMENT



General arrangement of the m.s. "Okesa Maru"

The general arrangement of the engine room is given in the attached photo-plan, and auxiliary machinery and tanks therein are as follows :—

2—15 kw. Diesel generators (2)
1—Manœuvering air compressor (3)
1—Emergency air compressor (4)
1—General service pump (5)
1—Combined fuel oil transfer and spare lub. oil pump (6)
1—Fresh water pump (7)
1—Lubricating oil purifier.
1—Main switch board (9)
2—Starting air bottles for main engine (10)
2—Ditto for dynamo engine (11)
1—Fuel oil tank for main engine (12)
1—Ditto for dynamo engine (13)
1—Lubricating oil reserve tank (14)
1—Light oil tank (15)
1—Bilge well (16)
1—Dirty oil tank (17)
1—Electric oil heater for lubricating oil purifier (18)
1—Silencer for main engine (19)
2—Silencers for dynamo engine (20)
1—Exhaust gas boiler (21)
1—Machine oil tank (22)
2—Feed pumps (23)
1—Feed water filter (24)
1—Exhaust steam receiver (25)

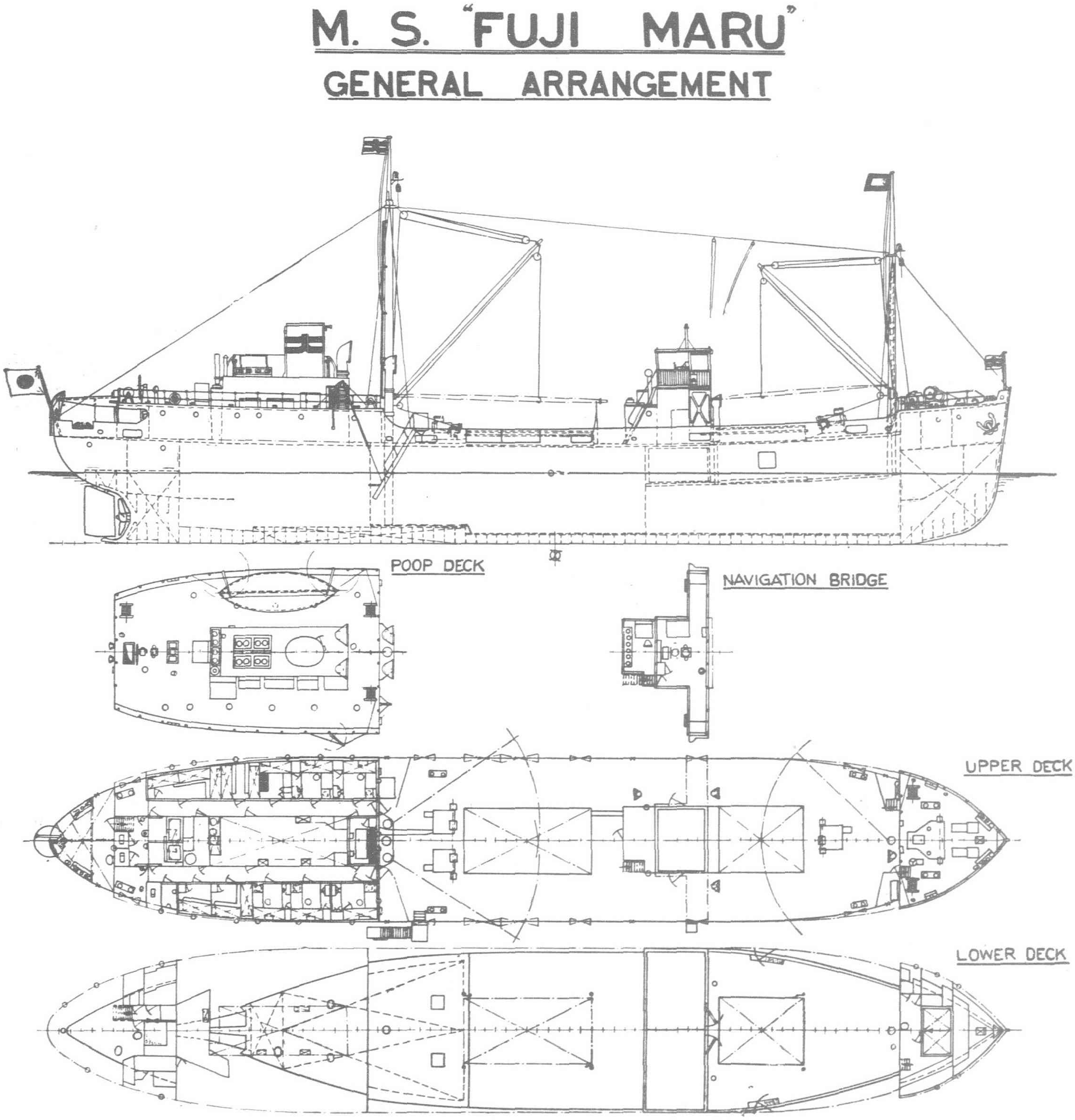
N.B.—Numbers in brackets correspond to marks in the plan.

All the auxiliary machinery is electric driven, except otherwise stated.

Trial Results

The official full power trial and progressive trial were carried out off Toshima mile posts on the Inland Sea on March 17, 1932. A mean speed of 14.429 knots was recorded in the full power trial with a mean engine output of 724 b.h.p. at 253.5 r.p.m. whilst in the overload trial a mean speed of 14.664 knots was attained with 833 b.h.p. at 262.5 r.p.m. The mean fuel oil consumption at full power was 119.5 kg. per hour or 165 grams per b.h.p. per hour. The whole results were entirely satisfactory to both the owners and builders.

A summary of the trial results is given in Table I.



General arrangement of m.s. "Fuji Maru"

Cargo Motorships "Fuji Maru," "Kiso Maru" and "Aso Maru"

These are sister ships built in the Mitsubishi Kobe Dockyard to the order of the O.S.K. Line for special freight service between Osaka and Kagoshima. They are considered superior express motorships of medium size for such service.

Leading particulars of these vessels are as follows :—

Length over all	180-ft. 0-in.
Length between perpendiculars ..	170-ft. 0-in.
Breadth moulded	30-ft. 0-in.
Depth moulded	17-ft. 6-in.
Gross tonnage	704 tons
Fully loaded draught	13-ft. 0-in.
Dead weight capacity	750 tons
Cargo capacity	42,000 cub. ft.
Camphor room capacity	1,000 ,,
Refrigerating room capacity	1,800 ,,
Trial speed	13.5 knots

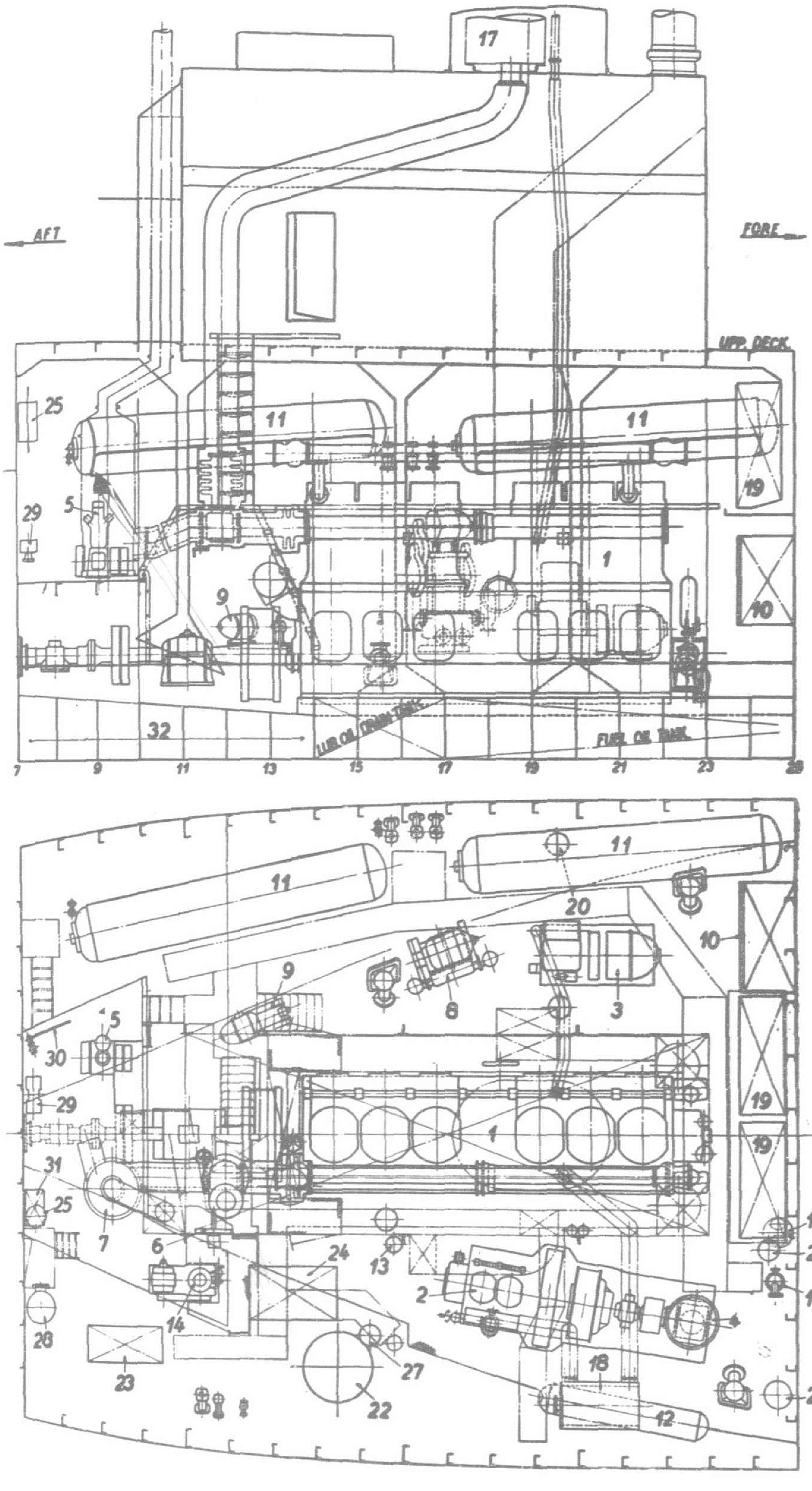
MAIN ENGINE.—One set of Mitsubishi airless injection Diesel engine type RH6.

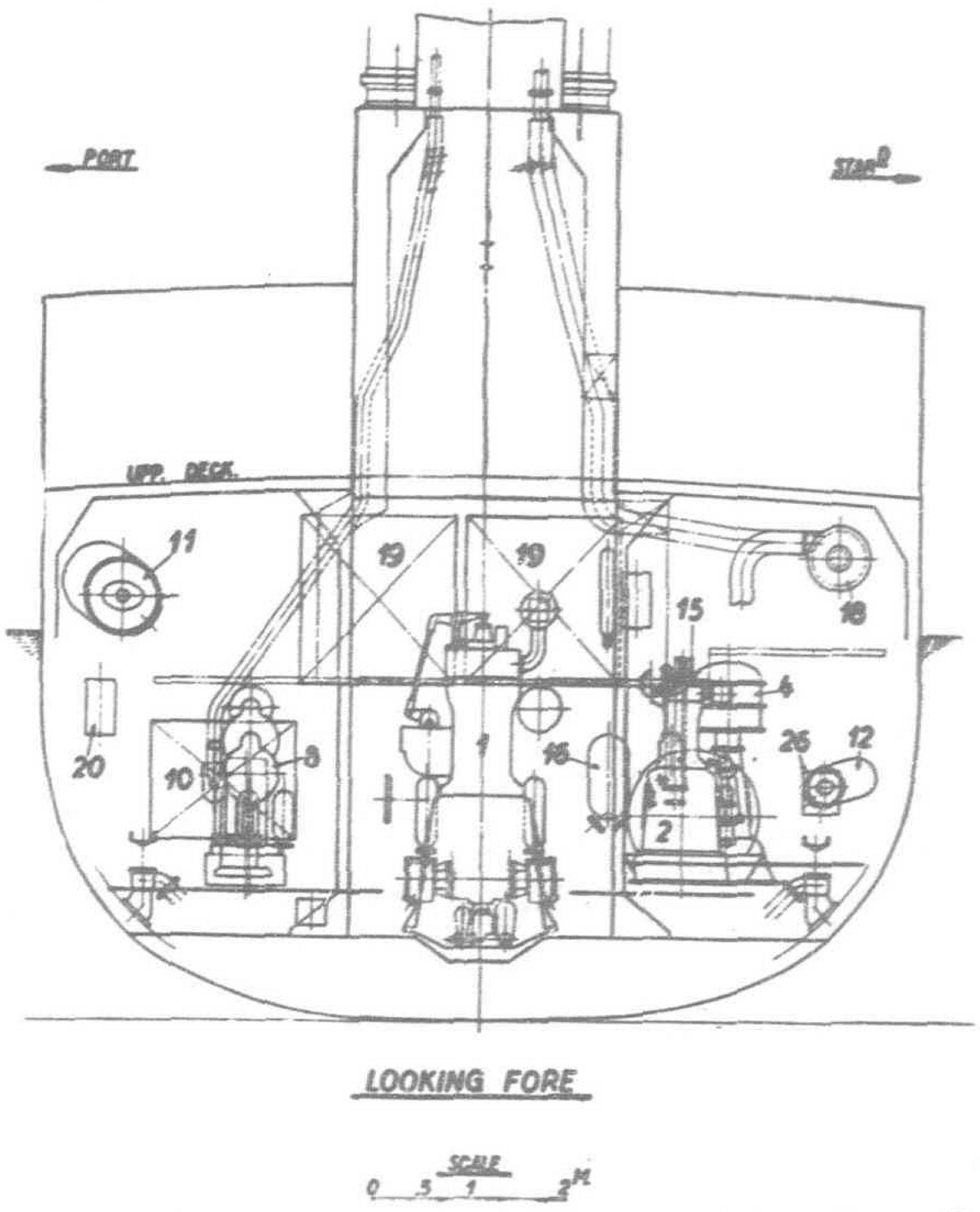
General Arrangement

The vessels have a cruiser stern, a forecastle, a poop, two masts and a dummy funnel on the top of the engine room at stern. On the upper deck amidships, a deck house is constructed which is utilized for a camphor store and a refrigerating machinery room, and over that a navigation bridge is situated.

The hull is subdivided into five compartments by four watertight transverse bulkheads. The foremost part is a peak tank, adjacent to this are two large cargo holds. No. 1 hold has a second deck, on which two refrigerating chambers are arranged at aft part, whilst No. 2 hold is the largest cargo hold extending from the bottom to the upper deck. Abaft this cargo hold is an engine room and an aft peak tank.

It is worthy to note that large refrigerating chambers are provided for the transportation of raw fish with a complete refrigerating installation, the machine having a capacity of 2.5 tons





Engine Room arrangement of m.v. "Fuji Maru." For reading of numerals refer to text

with ammonia expansion system, whilst the camphor room is for carrying camphor which is a special product in Kagoshima district. Further, in order to carry cows on deck, hitching devices are fitted.

Fuel oil is stowed under the machinery room and also in a double bottom constructed in aft part of the No. 2 hold.

Officers' and crew's accommodations are arranged in the long poop, which comprise cabins, a mess-room, a galley, bath-rooms and lavatories.

Steam required for heaters, galley and baths is supplied by an exhaust gas boiler installed in the engine room.

Cargo handling appliances consist of three Mannesman's steel booms and three 2 ton electric winches, one 2 ton boom being provided for No. 1 hold, and two 4 ton booms for No. 2 hold.

A powerful electric windlass is installed on the forecastle deck whilst an electric capstan is fitted on the poop deck. The steering arrangement comprises a direct coupled electric steering gear at stern controlled electrically from the wheel-house and the rudder is of a double plated balanced type to ensure the simple and quick manœuvering of the ship.

Main Engine and Auxiliaries

The main engine comprises one set of Mitsubishi four cycle airless injection trunk piston Diesel engines of type RH6 with six cylinders of 425 mm. in bore and 600 mm. in stroke, developing normally 750 b.h.p. at 210 r.p.m. The mean overload output in the sea trials was 903.5 b.h.p. at 231 r.p.m.

The design and construction are very similar to those of the main engine of the m.s. *Okesa Maru*, except that this engine consists of two groups of cylinders, each having three cylinders, and the manœuvering devices are arranged between them i.e. in the middle of the engine as shown in the photograph. Further the diameter of cylinders was increased by 25 mm., while the stroke is kept same, and the speed is reduced to 210 r.p.m. from 240 r.p.m. of that of the *Okesa Maru*, so as to make the engine more suitable for this type of cargo vessel.

As to the auxiliary machinery, this vessel having three electric winches, a large electric refrigerating installation, an electric steering gear, etc., the capacity of electric generators is increased by 33 kw. for that one more Diesel engine generator is installed. Further, the exhaust gas boiler is fitted with an oil burning unit and several pumps are increased in number. Consequently, there is a substantial change in the engine room arrangement from the *Okesa Maru* as seen from the photo-plan.

Auxiliary machineries, air reservoirs, various tanks, etc., in the engine room are as follows :—

1—33 kw. Diesel generator (2)
1—15 kw. Diesel generator (3)
1—Manœuvering air compressor (4)
1—Main engine driven air compressor (5)
1—Emergency air compressor (6)
1—Exhaust gas boiler with oil burning unit (7)
1—Bilge and ballast pump (8)
1—Oil fuel transfer pump (9)
1—Main switchboard (10)
2—Starting air bottles for main engine (11)
1—Ditto for dynamo engine (12)

TABLE I.—SUMMARY OF TRIAL RESULTS.

	M.S. "Okesa Maru"				*M.S. "Fuji Maru"*				
Date	March 17, 1932.				March 23, 1932.				
Place	Off Toshima, Inland Sea.				Off Toshima, Inland Sea.				
Distance of mile posts	One nautical mile.				1 n.m.				
Atmospheric pressure	767.5 mm.				764.3 mm.				
Weather	Fine				Cloudy.				
Sea	Calm				Slight				
Wind	WSW 3.7 meter per second.				SE 2.9—4.7 meter per sec.				
Load	*Over*	*Full power*	¾	½	½	¾	*15% over*	*Full*	*Full continuous*
R. P. M.	262.5	253.5	233	204	181.5	208.5	231.0	220.5	219.3
Speed, knots	14.664	14.429	13.667	12.156	11.538	12.578	13.513	13.186	—
Mean effective press. kg/cm.²	7.27	6.70	5.70	4.86	5.03	6.52	7.72	7.17	7.19
I. H. P.	960	853	667	498					
B. H. P.	833	724	537	372	535.5	796.5	1044.5	926.5	924.7
Lubricating oil press. kg/cm.²	1.2	1.3	0.9	0.7	408.5	654.0	903.5	782.5	781.2
Cooling water pressure kg/cm.²	0.5	0.4	0.5		0.8	1.0	1.1	0.9	1.1
Temp. C°									
Cooling water				0.3	0.9	0.7	0.8	0.6	0.9
cylinder inlet	8	9	9	9	9	9	9	9	9
cylinder cover inlet	36	37	41	40	44	40	38	38	37
engine outlet	28	39	38						
Lub. oil				32	45	41	41	40	40
cooler inlet	8	11	14	17	16	20	23	28	37
cooler outlet	8	10	11	13	engine outlet				
Crank chamber	21	24	28	29	21	26	30	30	38
Engine room temperature, C°	9	9	10	10	16	16	17	18	19
Sea water temperature, C°	7	7	7	7	8	8	8	8	8
Fuel consumption, kg/hr.	—	119.5	—	—	—	—	—	—	135.7
Ditto, gram/b.h.p./hour	—	165	—	—	—	—	—	—	173.8

1—Emergency air bottle for dynamo engine (13)
1—Lubricating oil purifier (14)
1—Lubricating oil cooler for main engine (15)
1—Air separator for main engine cooling water (16)
1—Silencer for main engine (17)
1—Ditto for dynamo engine (18)
2—Fuel oil tanks for main engine (19)
1—Ditto for dynamo engine (20)
1—Light oil tank (21)
1—Lubricating reserve tank (22)
1—Dirty oil tank (23)
1—Cleaned lubricating oil tank (24)
1—Fuel oil tank for boiler (25)
1—Compressor oil tank (26)
1—Machine oil tank (27)
1—Exhaust steam receiver (28)
1—Feed pump (29)
1—Hand feed pump (30)
1—Feed water filter (31)
1—Bilge well (32)

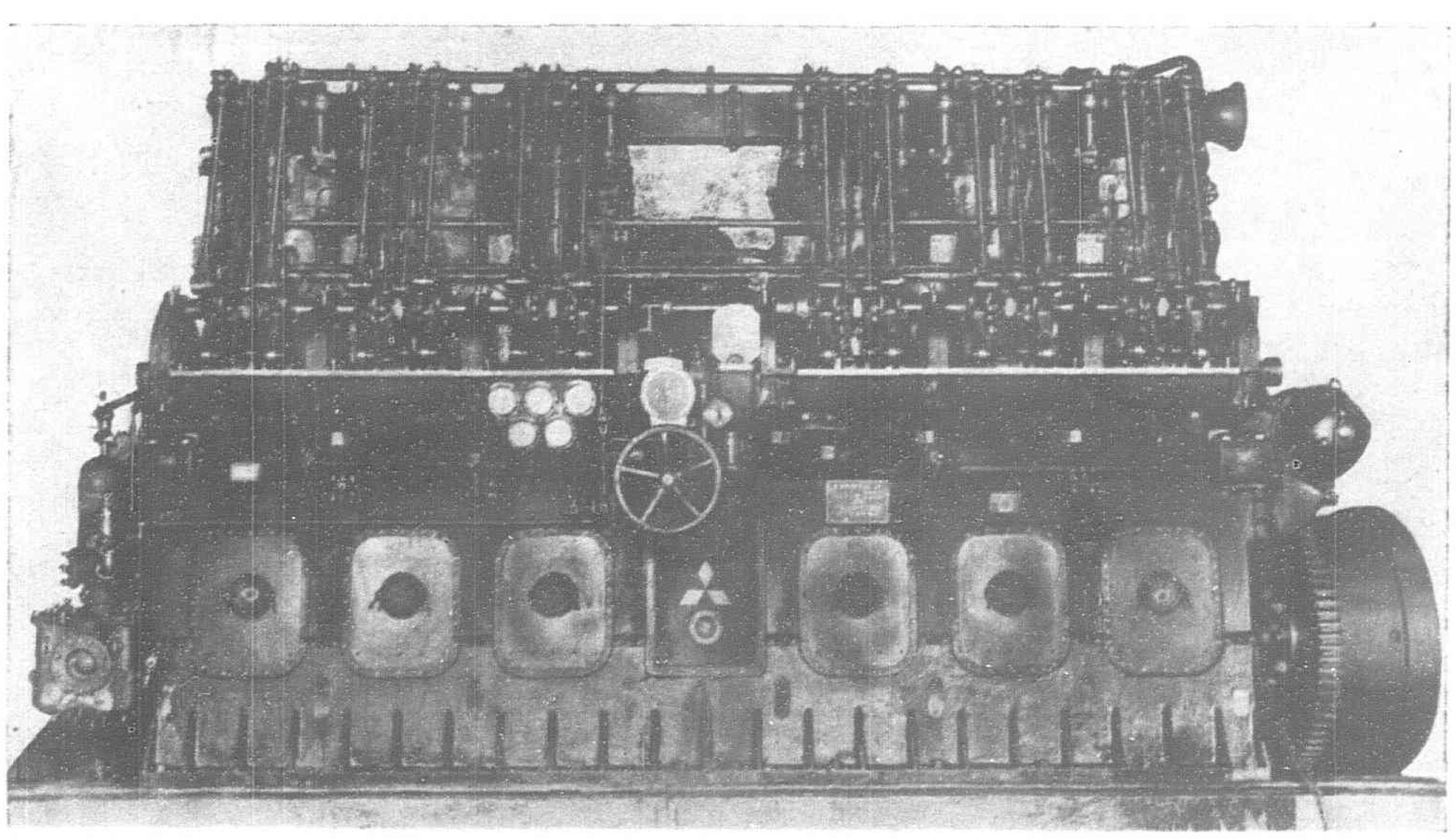
N.B.—Numbers in brackets refer the marks in the plan.

Trial Results

The official measured mile speed trials were carried out on the Inland Sea on March 23, 1932, and a mean speed of 13.186 knots was attained with a mean engine output of 782.5 b.h.p. at 220.5 r.p.m. whilst at 15 per cent. over load trials, a mean speed of 13.792 knots with 903.5 b.h.p. at 231.0 r.p.m. was obtained.

In the fuel consumption trial, a mean value of 135.7 kgs. per hour or 173.8 grams per b.h.p. per hour was recorded. All trials were quite successfully carried out to the entire satisfaction of both the owners and builders.

A summary of the trial results is given in Table I.



Main Engine of the m.s. "Fuji Maru"

The m.s. "Shunsan Maru"

The vessel was built and engined by the Yokohama Dock Company, Ltd., to the order of Messrs. Yamamoto Shoji Kaisha, Ltd., the keel having been laid down on March 2, 1932, launched on July 30, and completed on August 19, 1932.

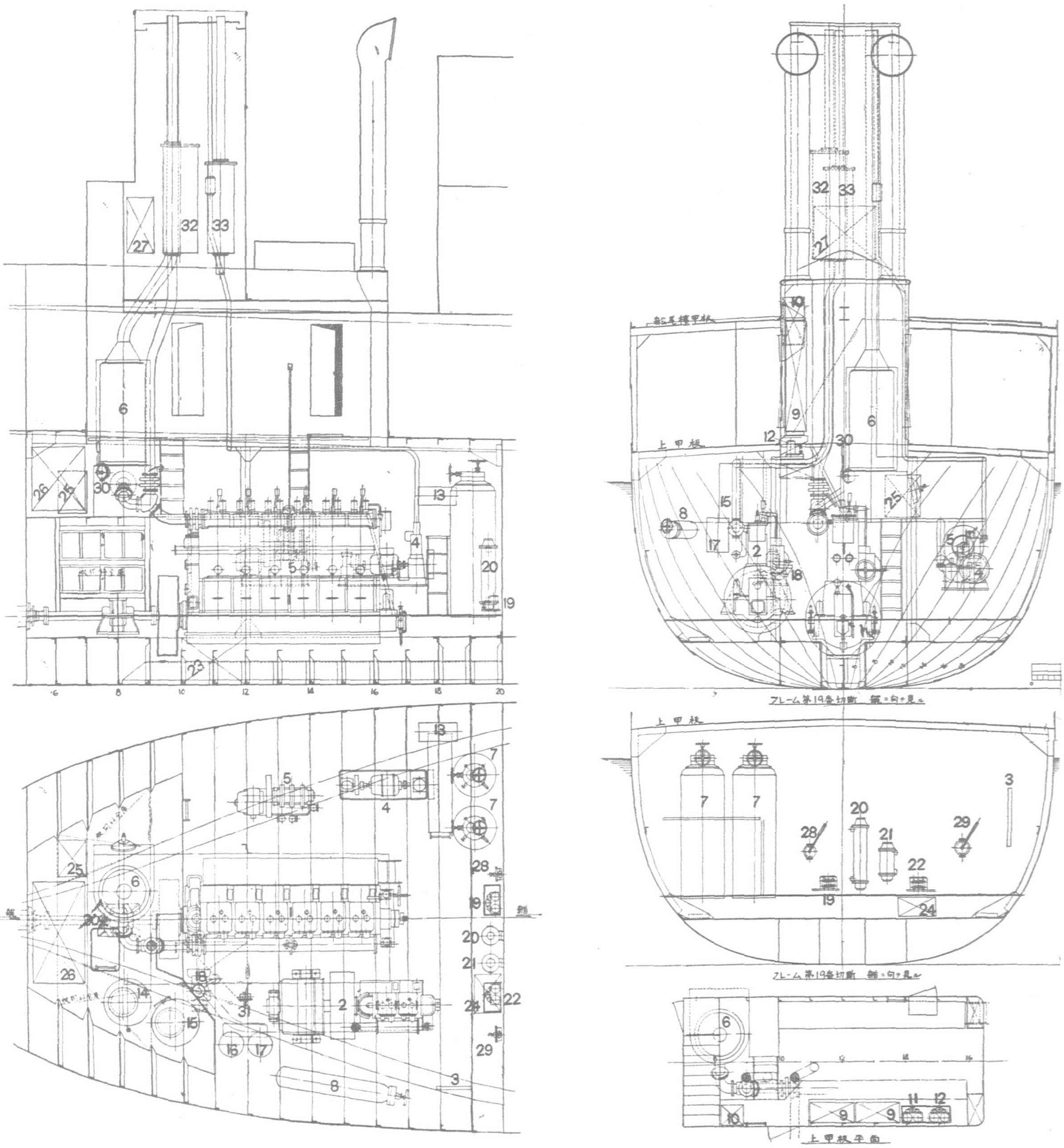
The leading particulars are as follows :—

Length over all	138 ft. 0 in.
Length between perpendiculars	130 ft. 0 in.
Breadth moulded	23 ft. 9 in.
Depth moulded	12 ft. 7 in.
Trial speed	11.153 knots
Gross tonnage	295.82 tons
Dead weight capacity	399.11 ,,
Cargo capacity, grain	504.11 ,,
,, bale	441.21 ,,
Propeller	One in number.

MAIN ENGINE.—One set of Yokohama-M.A.N. four cycle airless injection Diesel engine of 300 b.h.p.

General Arrangement and Hull Construction

The owner's requirements for the initial design of this ship were that the vessel should be able to navigate safely in very rough weather without a considerable reduction of speed, and also the appearance should be smart and well proportioned so as to receive guests or passengers. Consequently, the designer adopted a raked stem slightly clipped at top and a yacht type stern, and



Engine Room arrangement of m.s. "Shunsan Maru"

for sea-worthiness a forecastle, a poop and a high navigation bridge.

The vessel has only one deck extending over the whole length and the hull is subdivided by three transverse watertight bulkheads into a fore peak tank, forward and midship cargo holds, an engine room and an aft fresh water tank. The double bottom is constructed under the engine room and a part of the cargo hold for the stowage of fuel oil and lubricating oil.

On the upper deck amidships, a large hatchway is provided, and on the front of the hatchway a fore mast is fitted and abaft is a derrick mast, to these two 2 ton electric winches, steel derrick booms and all other necessary gears for the cargo facility are provided.

For anchoring and mooring, a powerful electric windlass is installed on the forecastle deck, whilst a hand capstan is fitted on the poop deck.

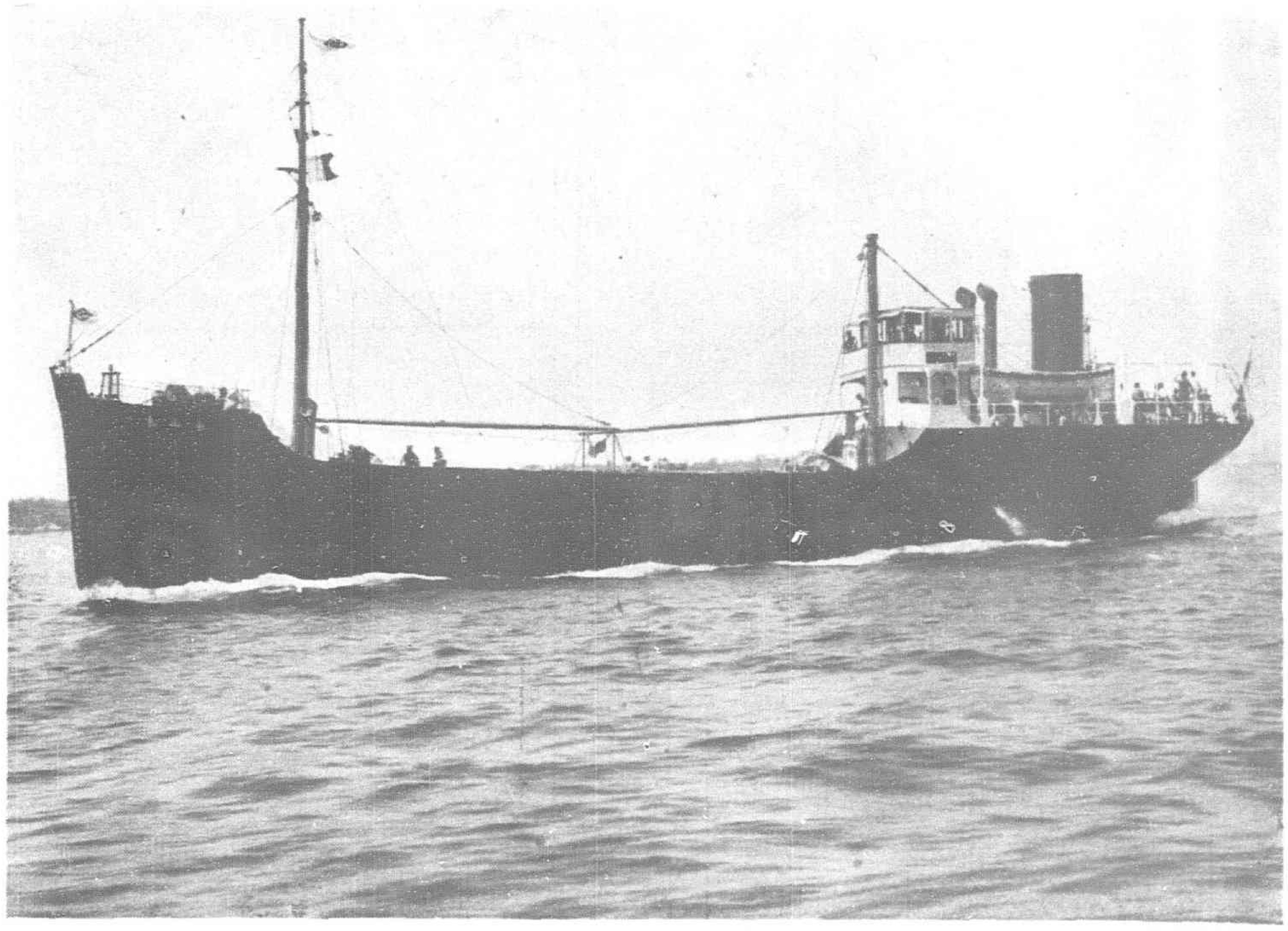
The rudder is of the Yokohama patent balanced aerofoil type which is controlled by a hand steering gear and is said to possess an increased propulsive efficiency, easy handling and a maximum rudder efficiency.

On the long poop deck are life-boats, "temma" (Japanese junk), capable of taking over all the ship's complement and passengers, and are secured well so as not to be washed away by waves in rough weather.

In the forecastle are various stores, and in the poop are a guests' or passengers' room of large size, officer's rooms, a dining-room, a galley, bath-rooms, lavatories and ready use provision rooms. Special precautions are taken for the entrances, ventilation, heating, lighting, furnishing and fittings.

The guests' or passengers' room and dining-room are beautifully decorated under the special request of the owners, such being an outstanding feature in this class vessel. The guest room is in Japanese style with "tokonoma" (alcove) and "tatami" (thick Japanese flooring) covered with beautiful carpets, where five guests can comfortably be received. The dining-room is in the well designed European style.

On the poop deck forward is the captain's room, and above it the navigation bridge is situated, where a hand steering gear, a compass, speaking pipes and engine telegraphs are fitted. On the top of the wheel-house, a search-light is fitted to both sides in order to ensure the safe navigation as well as cargo handling at night.



The m.s. "Shunsan Maru" on Trial Run

Main Engine and Auxiliaries

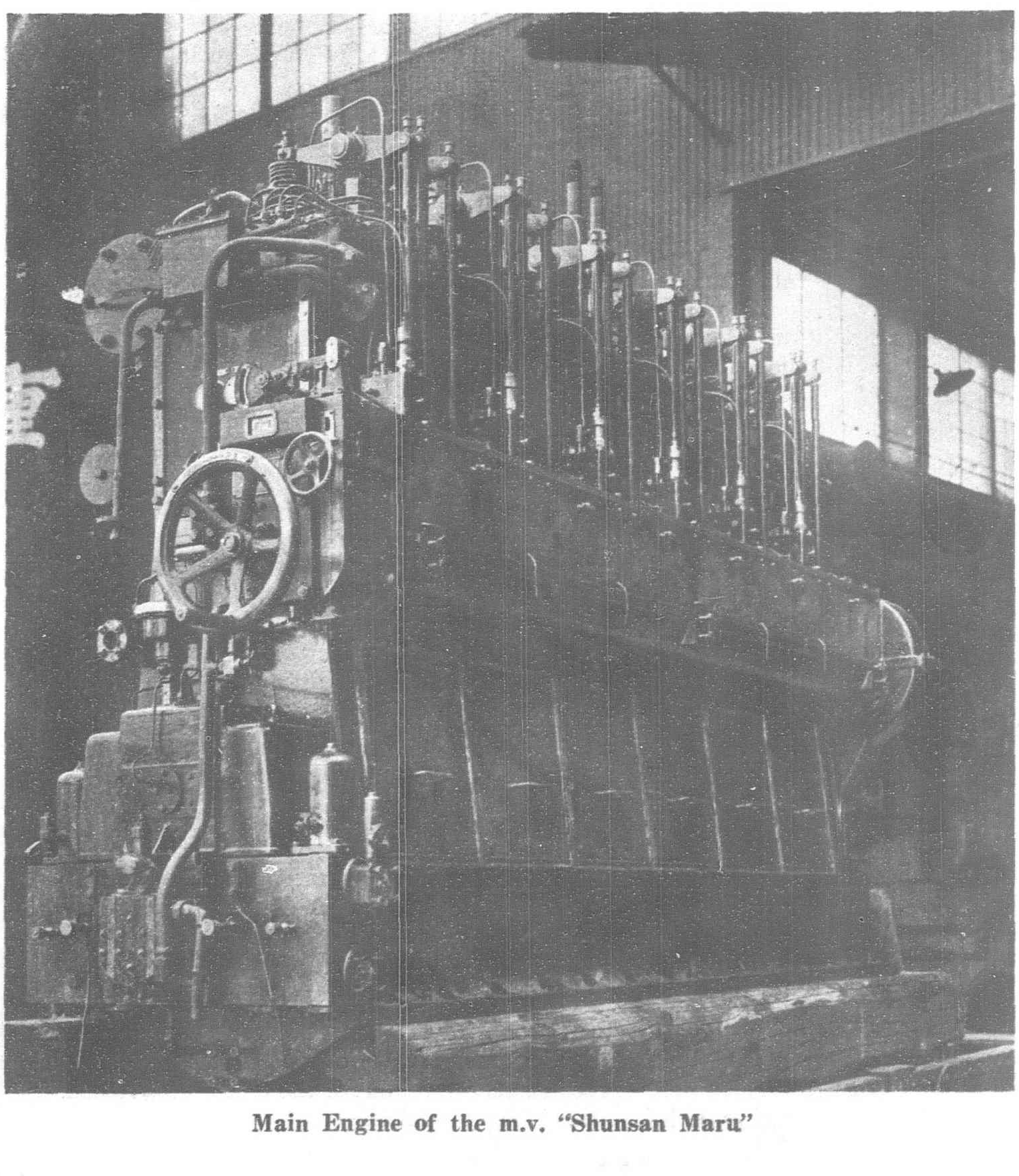
The engine room is situated at stern. Special endeavor of the designer can be perceived by the compact arrangement of the propelling machinery, electric generators, auxiliaries and exhaust gas boiler in such a comparatively limited space as is seen in the plan attached.

A comparison with similar stern engined motor cargo ships and a motor tanker built in the same yard recently is given.

	Length of Ship.	*Length of Eng-Rm.*	*Ratio*
Motor Tanker *Kaisoku Maru* ..	221.5-ft.	52-ft.	4.26
Cargo Motor S. *Ume Maru* ..	145 ,,	32 ,,	4.54
Cargo Motor S. *Shunsan Maru* ..	130 ,,	26 ,,	5.00

The length of the engine room of the *Shunsan Maru* in only one-fifth of the length of ship, yet all necessary machinery is very conveniently arranged.

The main engine is one set of the Yokohama-M.A.N. four cycle airless injection G6VU42 type Diesel engines with six cylinders of 275 mm. bore and 420 mm. stroke, developing normally 300 b.h.p. at 320 r.p.m. The engine being direct reversible type, all necessary auxiliaries for propulsion are directly coupled to the main engine, so that it is unnecessary to use the electric generators except at night or to drive other independent auxiliary machinery. Consequently, the handling of the engine is very simple, so that only three engineers including the chief engineer are on board.



Main Engine of the m.v. "Shunsan Maru"

As to the construction of the engine, the bed plate, frames and cylinders are of cast iron and are firmly fastened together by four long stay bolts to constitute the main body of the engine and to prevent tensile stress to these castings by means of transmitting the combustion pressure on the cylinder covers to main bearings on the bed plate. Consequently, the casting is made as light as possible, whilst the whole engine body is constructed as a deep strong built-up beam to withstand the bending moment due to the inertia force of moving parts and also to prevent vibration.

Cylinder covers, jackets and liners are of special cast steel and are separately made for easy renewal and inspection. Piston connecting rods, crank shafts and main bearings are of usual construction.

Fuel injection is effected by the well-known M.A.N. system, comprising fuel pumps and water-cooled open-type fuel injection valves fitted individually to each cylinder. The combination of these pumps and valves is, as is easily perceptible, very reliable and durable, and attained a record of fuel consumption at 169 grams per b.h.p. per hour in the shop tests, whilst on the overload sea trial, exhaust gas was very clear even at a mean indicated pressure of 8 kgs. per sq. cm. and still showing placidity of the engine.

This engine being of a small type, the reversing device is hand driven unlike some other engines, but the operation is very easy and light, only 5 to 10 seconds being required for the reversing from ahead to astern.

There are two electric generators. The larger one is for cargo handling, consisting of a Yokohama-M.A.N. GVU33 type 50 b.h.p. Diesel engine and a 30 kw. 225-volts D.C. dynamo supplied by the Fuji Electric Engineering Co., Ltd. The

smaller one is driven by a 6 h.p. petroleum engine supplied by Messrs. Tomono Iron Works, which also can drive an air compressor whenever necessary, and this in conjunction with the air filling device of the 30 kw. dynamo-Diesel engine can make starting air of 25 kgs. per sq. cm.

Further, in the engine room is a 3 h.p. general service pump which can be independently used for pumping bilge, ballast water as well as for fuel oil transfer.

Although the ship is small, special care has been given for the exhaust gas boiler installation, which can produce steam at a pressure of 1 kg. per sq. cm. by the exhaust gas of the main engine only, which can be readily used for the heating, cooking and baths. This boiler has a diameter of 760 mm. and a height of 260 mm. with a very large heating surface for the absorption of exhaust heat and also can be utilized as a silencer. A Yokohama special simple burner being fitted, steam can be produced by burning oil as well when in port or whenever required, for that compressed air or steam is used.

A DeLaval's lubricating oil purifier is also fitted in the engine room.

Trial Results

The official measured mile trials were carried out off the Yokohama Harbor on August 15, 1932, and the following results were obtained :—

Sea : rough
Draught, mean : 1.7 meters.
Speeds : Maximum 12.481 knots ; mean 11.153 knots
R.P.M. of the main engine, mean : 344.5
B.H.P., mean : 351.5

For the starting and reversing tests, an air tank of 800 liters at 25 kgs. was used and it was possible to start the engine 18 times astern and ahead alternately.

Railway Construction Pushed by Manchukuo

(Continued from page 203)

freight traffic and of passengers (the latter of secondary importance) will be an interesting study, as farm products from Manchuria are bound to increase by leaps and bounds, providing the new state is wisely governed by the experienced leaders at its helm. They must provide peace and order for the people. It is necessary that the people be led with care, firmness and patience. They have been brought up under the corrupt and easy-going old-fashioned régime and they cannot be rushed headlong into ultra-modern fashions in a controlled and planned economic scheme all of a sudden.

Below are data for the state lines managed by the Mukden bureau.

Some of the figures for these state lines are misleading, as they were built by soldiers or by forced conscript labor. The mileages of the three systems are :

	Miles
Manchukuo Railways	2,146
Chinese	1,150
South Manchuria	700
Total	3,996

Until the present they never operated along the lines of business-like co-operation. But things are improving as order is being restored. As it continues to be maintained we shall be able to see how these nearly 4,000 miles of railways will open up the fertile valleys of North Manchuria, where the possibilities are still virtually unknown.

MANCHUKUO STATE LINES

Railway	*Miles*	*Construction Cost*	*1931 Revenue*	*Expense*	*Balance*
		In 1,000 silver dollars			
Changchun-Kirin-Tunhua	211	33,967	5,167	4,263	904
Ssupingkai-Taonan	273	25,000	8,100	6,000	2,100
Taonan-Anganghsi	140	12,600	4,425	2,529	1,896
Tsitsihar-Koshan	132	8,910	2,825	1,370	1,455
Taonan-Solun	52	470	65	80	—15
Hulan-Hailun	138	12,000	4,471	3,030	1,441
Mukden-Hailung-Kirin	313	41,500	11,395	6,380	5,015
Mukden-Shanhaikwan and branches	887	48,430	10,362	7,875	2,487
Total	2,146	182,877	46,810	31,527	14,283

Electric Service Corporation

An item of unusual interest in the business activities of Shanghai is the recent change in ownership, operation and policy of one of the established Nanking Road firms, conceded to be one of the pioneers in the radio industry in the Far East.

During October, Mr. Harry S. Janes, for many years Vice-President and Director of the Automatic Electric Company of Chicago, together with a group of interested friends, acquired the controlling shares of the Electric Service Corporation, whose head office is at No. 20 Nanking Road, Mr. Janes thereby becoming its active head and President, and Mr. Roy E. De Lay retiring. The Electric Service Corporation has retail shops at 20 and 118 Nanking Road and in the Navy Y.M.C.A. building, beside the Willard Storage Battery Station in the Western district.

Under the new management, Mr. John F. Stevens, Jr., has become first Vice-President, and will devote his time to sales organization and will be in direct charge of the company's interests under Mr. Janes. Mr. Stevens is the son of the famous engineer and railroad builder in America, who was responsible for the building of the Panama Canal and who is known to many in this part of the world as chairman of the Inter-Allied Technical Board, in charge of operation of the Chinese Eastern and Trans-Siberian Railways in Manchuria.

The new arrangement of this company provides for a Nanking Road Service Department, under the supervision of Mr. Eric Marshall, Works Manager. Mr. Marshall has had many years' experience in radio application, as well as other sound-producing lines, and will be assisted by Mr. C. P. Taylor, Service Manager, who will be in charge of the Works Office.

Japan's Electrical Trade

Japan's imports of telegraph and telephone apparatus as a whole decreased sharply between 1928 and 1931. In the former year their value was Y.3,982,000 ; in 1930, Y.1,834,200 ; and in 1931, Y.1,224,400. The trade in radio receiving sets and parts was, however, fairly well maintained, and imports last year were Y.417,700 in value, as compared with Y.322,600 in 1930 and Y.594,000 in 1928.

A large amount of automatic telephone material has been installed in Japan, a great proportion being of American origin, and most of the remainder German. Not only has the system been in operation for some years in the large cities, but it has also been introduced in a few of the smaller towns, and at the end of 1930 there were said to be 108,100 American automatic telephone installations and 30,500 German, besides 6,000 of English origin.

The United States during the period under review made substantial progress in the trade in low-pressure electrical material, partly because of the participation of two powerful American electrical manufacturing concerns in Japanese production by the establishment of branch factories in the country. This step had a beneficial influence with the authorities in connection with contracts for material not made locally.

The greater proportion of the trade in radio receivers fell to the United States, but orders have been on a low level recently because of the prevailing depression. In ignition apparatus the trade is shared between the United States, Germany, Great Britain, and Switzerland. German batteries are said to be dear compared with American. In electro-medical apparatus, however, Germany has recovered her pre-war position.

In regard to Japanese production of low-pressure apparatus it is difficult to obtain precise details. Apparently 86 per cent of the country's requirements of telegraphic and telephonic material are supplied by local manufacture, but at the same time it is evident that opportunities for import trade continue to arise as new inventions and improved designs are placed in the market by American and European firms. Nor is it considered likely that import trade will cease in the more complicated apparatus connected with long-distance signalling, electro-medicine, measuring, and automatic regulation.

When normal conditions return there should be a demand for the latest products of the radio industry, including both telegraphy and telephony, and for materials for television. There should also be a market for improved cinematograph apparatus.—*Electrical Review.*

Engineering Notes

INDUSTRIAL

OIL STORAGE TANKS—Mr. Kojiro Matsukata, of Japan, has decided to purchase land covering 15,000 tsubo in the Tsurumi reclaimed area, on which to construct storage tanks, in connection with his recent oil contract with the Naphtha Export Trust of the U.S.S.R.

PLANT IN MANCHURIA—The construction of the first hydro-electric station in Manchuria with a capacity of 50,000 kw. is proposed by the Manchukuo Government. The South Manchuria Railway Co. is also contemplating the erection of a 50,000 kw. thermal station for the extension of its existing undertaking.

ARSENAL FOR TUNGCHOW—The construction of an arsenal at Tungchow, about forty miles East of Peiping, has been decided upon by the Peiping Military Commission. Plans are being drafted by the German experts. A sum of $150,000 for construction of an aviation field at Tsinghua Yuan, near Tsinghua University, was also appropriated.

CANTON PROJECTS—In a rapid survey of Canton's progress, Mayor Liu Chi-wen stated that a new electric plant of 24,000 kilowatts is to be established in Honam. To prevent erosion, the Honam Bund is to be constructed from Chow Tou Chiu (opposite Shameen) to the Chukiang bridge and preparations are being made to construct another bridge from the Bund to Ou Chow Street, Honam. The bridge will be close to the wharves, now under construction.

THREE YEAR PLAN—The Kiangsi Provincial Department of Reconstruction is drafting a three-years program for industrial development in Kiangsi. The plans include the opening of farms and ranches, establishment of an experimental brewery station, development of the forests at Hwangkang (north-western Kiangsi), opening of sericultural experimental stations and tea plantations. Steps will also be taken to exploit the coal mines at Yukan (north-eastern Kiangsi) and Tienho (western Kiangsi). To facilitate communication services, a long-distance telephone system will also be installed.

JAPANESE HARBOR WORKS—Large quantities of sheet pilings have recently been consigned to Japan for harbor works in Osaka, Yokohama and smaller bases for the Japanese fleet on the West coast. These came from Germany, and are made from a special iron containing a percentage of copper, rendering them resistant to rust. The material is unusually tough and possesses a high tensile strength, so that the sheet pilings can be rammed into hard ground without bending. Although a similar material is being produced in Japan, the German was selected because it alone possesses the necessary qualities to provide the necessary watertight enclosure.

JAPANESE POWER PLANTS—The Yahagi Hydro-Electric Power Company set about constructing a power station at Taifu, in Gifu Prefecture, in December. Funds needed for the scheme will be about Y.11,000,000. Early in the New Year the Nippon Denryoku K.K. will prepare for the erection of its proposed 65,000 kw. Tsurigane power station; the work will be completed in two or three years. The Ujigawa Electric Company is also proposing to proceed with the erection of its Nagatono station (10,000 kw.) on the Obara River. In addition, applications have been filed for the operation of thermal power stations by the Sanyo Central Hydro-electric Power Company (35,000 kw.), the Kobe Municipal Electric Bureau (35,000 kw.), the Osaka Municipal Electric Bureau (10,000 kw.), and the Nankai Railway Company (10,000 kw.).

NANKING WATERWORKS—A contract has been signed between the Municipality of Nanking and a banking syndicate for a loan of $300,000 for the completion of Nanking Waterworks. Work has been going on for some time, but due to financial difficulties of the Municipal authorities, progress has been retarded.

DAIREN SULPHUR FACTORY—Officials of the Ministry of Overseas Affairs and representatives of the South Manchuria Railway Co., have decided to establish a sulphur factory in Dairen with a capital of Y.20,000,000. The factory will produce 100,000 tons of sulphur yearly, according to estimate.

HAICHOW HARBOR—According to a Chinese report from Hsuchow the Siemens Company has been granted a contract for $1,000,000 for the construction of the harbor at Haichow, which is the eastern terminus of the Lunghai Railway, which will eventually run from coast into the far north-west of China through Sianfu, the Shensi capital.

IMPROVEMENT SCHEME—An elaborate plan for the beautification of Tokyo is shortly to be put into effect if plans of the Ministry of Home Affairs materialize. This will be the first application of Article 15 of the Town Planning Law, which gives the Home Office the right to designate the kind of building which may be erected within a certain area, etc. The Home Office also has under consideration a plan for improving all towns and cities within a radius of about 60 miles from Tokyo Station.

GAS COMPRESSOR—The Ishikawajima Shipbuilding and Engineering Co., Ltd., which holds a license for building Sulzer high pressure gas compressors, has recently booked an order for a five-stage gas compressor and a circulating pump for the new Nagoya ammonia works of the Yahagi Suiryoku K.K. The gas compressor will have a capacity of 3,400 cub. meters per hour at a pressure of 150 atm. (2,150 lb. per sq. in.), whilst the circulating pump will be constructed for handling 275 cub. meters per hour at pressures of 130 to 150 atm. These machines will be built in Japan, with the exception of certain sensitive parts, such as valves, stuffing-boxes and regulating devices, which will be made in the Sulzer Works at Winterthur.

RAILWAYS

EXTENSIONS IN JAPAN—The Atenmi Electric Railway is to be extended from Tawaramachi to Fukuye (10 km.) at a cost of Y.500,000, and the Ikegami Electric Railway for a distance of about 1 km.

PROPOSED NEW LINE—The Kiangsu Department of Reconstruction is drawing plans for a railway linking Haichow, on the northern coast, with Tungchow, near the mouth of the Yangtze. The railway, which will pass Yencheng, Fowning, Kuanyun, and other important cities, will be approximately 200 miles long, and will link up with the Lunghai Railway at Haichow. Surveys are now being conducted.

ORDERS FOR ENGLAND—$1,900,000 has been set aside for the purchase of locomotives and coaches for the Canton-Shaokwan Railway and the Canton-Samshui Railway. Orders for these vehicles will be placed with engineering firms in England. Four motor coaches will be placed on service on the Canton-Shamshui Railway, running between Canton and Fatshan. These will also be ordered from England, each vehicle holding one hundred passengers. Passenger traffic on this line has increased tenfold compared with a year ago.

LIGHT RAILWAY—Construction is expected to start soon of a light railway which is to run between Wuhu and Chapoo, a town to the east of the Yangtze city. The project will cost about $2,000,000 and it is to be financed by capital raised from private sources.

MATERIAL ARRIVES—Shipments of railway materials purchased by the Ministry of Railways for the construction of the Chuchow-Shiuchow section of the Canton-Hankow Railway are arriving from England. The first shipment has already reached Canton while the second is due. The first shipment consists of 65,092 pieces of wooden sleepers and 31 steam shovels, costing £19,300. They were purchased from funds made available from the British Boxer Indemnity Refund.

SURVEY PLANNED—Arrangements are being made by the Kiangsi Provincial Department of Reconstruction for the loan of engineers from the Chekiang Provincial Authorities to survey the proposed Nanchang-Kiangshan railway line. With the Hangchow-Kiangshan Railway nearing completion, the Kiangsi authorities are planning the construction of a Line as a continuation of that railway to Nanchang. The cost of the survey will be about $113,000 and will take nearly a year to complete.

PROPOSED RAILWAY—Canton, February 22.—The construction of a light railway as an extension of the Canton-Samshui Railway terminating at the port of Wuchow in S.E. Kwangsi, was decided upon at a meeting of the South-western Political Affairs Committee. The proposed railway will pass Szewui, Kwangning, and other populous cities in western Kwangtung before terminating at Wuchow, just across the Kwangsi border. At present river steamers constitute the only means of communication between the two provinces.

PLANE EXPANSION—A project to double track the Nanking-Shanghai Railway line between Chinkiang, Nanking, Soochow, and Shanghai is being considered by the Ministry of Railways, according to vernacular press statements.

It was said last night that Mr. Koo Meng-yu, the Minister of Railways, has approached local bankers with plans which call for the raising of $4,000,000 for the project. This sum will be used for the construction of double tracks between Shanghai and Soochow, which is the first provision of the Ministry's plan, it was declared. The reason for the contemplated project is because of the commercial expansion of the districts between the railway terminals mentioned.

LINK LINES IN CHINA—It is said that the Canton authorities are now willing to link up the Kowloon-Canton Railway with the Canton-Hankow Railway by a loop-line at Canton, provided a foreign loan of $15,000,000 is forthcoming to develop the province of Kuangtung. The two lines at Canton are separated by about six miles. The southern section of the Canton-Hankow Railway will be completed in about four years, now that funds are available from the British Boxer Indemnity. From Canton the railway goes as far as Shaokuan, and from Hankow the line runs down to Chuchow in Hunan. The portion from Shaokuan to Lohchang will be completed in eight months, but the section between Chuchow and Lohchang has to pass through high mountain ranges, hence the construction will take time and money. The construction of a loop-line joining the two railways is a very simple matter, but Canton has opposed such measure on the ground that its trade and prosperity will be captured by Hongkong. How far this view is modified by the proposed loan cannot be ascertained at present.